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State of Rhode Island and Providence Plantations.

FIRST ANNUAL REPORT

OF THE

Harbor Commissioners,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1877.

PROVIDENCE:
ANGELL, BURLINGAME & CO., PRINTERS TO THE STATE.
1877.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:—

The Board of Harbor Commissioners, established by Chapter 556 of the Public Laws, passed at the January Session of 1876, respectfully submit their first annual report.

The members of the Board were appointed on the 14th day of June, and organized on the 28th of the same month.

The Commissioners are aware that the duties which have been assigned to them are of a very important nature, and it will be their constant endeavor to aid and foster all the facilities for navigation now possessed and all improvements therein which may be projected by the citizens of the State and to avoid interference with any private enterprise looking to such improvements, except in cases where, in their judgment, public injury would otherwise result.

The admirable location of Narragansett Bay, reaching well inland at the northern limit of that portion of our Atlantic Coast, which can be reached by vessels from the middle and southern States, without passing the dangerous outer shore of Cape Cod, renders its improvement for navigable purposes of unusual importance. Within its shores there is sufficient room for the present commerce of the world to ride in safety. At its head lies a city of over one hundred thousand inhabitants, situated upon territory which gives a rare combination of suitable high ground for dwellings, and level ground for business, within easy reach of three streams furnis[illegible] water-power for manufacturing purposes, and to which, [illegible]paratively moderate expenditure, twenty feet navigation at low water can be brought. Two broad and deep entrances from the sea, one or the other of which can be made in a storm blowing from any direction, furnish easy access and make this bay an attractive haven to seafaring men.

An Advisory Board, consisting of Commodore Daniel Ammen, Chief of Bureau of Navigation; Major Gouverneur K. Warren, United States Engineer; Captain Carlisle P. Patterson, Sup't. U. S. Coast Survey, has been appointed by the President of the United States, to aid this Board in the consideration of such subjects as are of national interest, and their advice, which is rendered gratuitously, will be of the highest value.

Maps and plans in relation to our harbors and channels, obtained from the Coast Survey and from the Engineer Department of the United States, as well as others in possession of the city of Providence, and some from the office of the Secretary of State, with a few from other sources, have been or are being copied and collated so as to give us valuable information in regard to the changes which have occurred or may be going on within our public waters.

Believing that the ship channels have been injuriously shoaled by the dumping of ashes from steamers, the Commissioners requested the agents of the various lines to prohibit the throwing out of ashes above Sand Point, east of Prudence Island, above North Point east of Conanicut Island and above Sand Point in the western passage.

A dumping ground for the deposit of dredged material has been designated at the "deep hole" northwest of Rumstick Point, where all such material is now required to be carried. This ground is about nine miles from Providence harbor, but no suitable place above this is known to the Commissioners, and to go farther down the bay would not only cause increased expense but would subject the scows, at times, to a rougher sea than they could be expected to live in. A considerable portion, and perhaps the whole, of the dredged material can be taken care of in the construction of wharves within Providence harbor, if plans now under consideration are perfected, and it will be the aim of the Commissioners to aid in this result so far as they can.

The Commissioners, having studied the needs of Providence harbor, advised with the Harbor Committee of the City Council, as to the most desirable points for expending the money appropriated by the City Council for dredging, from which good accommodations for the heavy coastwise steamers at this port will probably result.

Consultations have been had with the Commissioners of Shell Fisheries in regard to the respective duties of the two boards.

The attention of the officers of the Providence and Worcester Railroad has been called to the injury likely to result to the harbor from the cutting off of an estimated volume of more than three million cubic feet from the tidal flow by the construction of a railroad embankment, without an opening, across a portion of Seekonk river, near Walker's Point. This volume should be restored to the tidal flow, without delay, by the construction of an adequate passage-way through the embankment.

Complaint having been made to the Commissioners of injury to the Pawtucket harbor, from the washing in of earth by storm waters from the highways of the town, and by the deposit of material above the dam, which washes into the harbor below, notice has been given to various parties responsible for such injury, to the end that a remedy may be provided.

Meetings have been held in Bristol, East Greenwich and Pawtucket, to give opportunity to the inhabitants to offer any suggestions in regard to the public waters. It is intended to hold similar meetings in other towns.

Many other subjects of interest in the development or preservation of the trusts committed to the Commissioners have been acted upon or are under consideration.

The Commissioners offer the following suggestions:

An office should be provided for the use of the Commissioners and the keeping of plans and records.

The harbor line of East Providence is unsuitable, in the opinion of the Commissioners, and they would suggest the repeal of the act establishing it. A new line will soon be proposed.

It is desirable that the duties of the commission in reference to improvements within harbor lines, be more fully defined. The experience of the Massachusetts Harbor Commissioners will probably be useful in this regard.

The commission would have greater apparent authority and probably greater weight in its appeals to Congress for aid in improving the harbor, if a clause directly conferring authority to act for the State, in such appeals, were added to the act.

Additional legislation may be needed to insure suitable wharf accommodations for transient shipping, on account of the practice of permanently occupying wharves for private business.

The desirability of requiring compensation, in kind or in money, for tidal space occupied by permanent structures, as is done in some States, should be considered. If such compensation is required in money, the funds resulting therefrom should be devoted exclusively to dredging ship channels near, or valuable to, the wharves or other structures, on account of which the money has been paid. While it is desirable to encourage, or at least to offer no obstacle to, the development of wharf property, such development should, in our opinion, only follow the legitimate demand, including a fair amount of accommodation in excess of immediate needs, for the purpose of inviting an increase of trade, and a moderate tax in compensation for public property resigned to private control and use ought not to be objected to, especially when it is made for the purpose of obtaining a fund to expend in repairing the injury caused by such private occupation and in increasing the value of the property so taxed. The reason for imposing such a tax consists chiefly in the fact that the main channels are preserved by the scour of the tides, and the efficiency of this force depends upon the volume of water which passes into and out of a basin at each tide. Any lessening of this volume will have a tendency to cause the channels to fill up, and to preserve them dredging must be resorted to. The question arises then as to the source from which funds for this dredging should be obtained, and although a part of it may fairly be raised by a general tax upon the community benefited by the increased facilities for trade, it seems most proper that the structures causing the injury should bear an additional part of the cost of the remedy. By this plan, also, the State which surrenders public property to private use, receives in-direct compensation therefor. There are rare cases in which the occupation of a moderate amount of tidal space, between high and low water, does not injure the channels, but it has been laid down as a law by high authority that "*Where the high water level of the surface of the river, estuary, or basin is the same as, or higher than, the level seaward of the point of abstraction, a diminution of tide-covered area will reduce the effective backwater.*" Backwater being the term by which the volume of water between high and low tide levels is designated.

Where the inner waters rise higher than the outer it may be concluded that the space for receiving the tidal flow is already smaller than is required for the fullest effect of tidal scour. This is the case with the waters of Narragansett Bay and Providence harbor; the waters pile up as they flow inland and it is safe to say that any lessening of the space between high and low water, to receive the tide is an injury and that artificial means must be resorted to to preserve the channels.

In view of all the facts of the case we recommend that a compensation fund be established from a tax to be levied on parties who displace tide waters by structures or otherwise, and that the fund thus obtained be used by the Board of Harbor Commissioners at their discretion in improving the channels most affected by the displacement.

It is supposed to be the duty of the commission to foster and develop the rights and interests of the State in the public waters as well as to prevent direct injury. In this view it is desirable that an amendment be made to the act, empowering the Commissioners to make such examinations and observations as they may deem necessary.

It is made the duty of the Harbor Commissioners to recommend such further legislation as they may deem proper, and they therefore submit herewith a new draft of the act, under which they were appointed, embodying such changes as seem to them desirable.

J. HERBERT SHEDD,
N. F. POTTER, } *Harbor Commissioners.*
JEDEDIAH WILLIAMS,

Eng 1010.3

State of Rhode Island and Providence Plantations.

SECOND ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1878.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1878.

State of Rhode Island and Providence Plantations.

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The Commissioners.

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Second Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, reappointed Jedediah Williams, whose term of service as Harbor Commissioner had nearly expired, for a further term of three years.

OFFICE.

The Commissioners have, in conformity with Chapter 611, of the Public Laws, secured an office in the city of Providence, at an annual rent of three hundred dollars, where they keep all charts, plans, and other papers and documents, which have come into their possession, and it also affords a convenient place for such hearings of parties as may from time to time be required.

APPLICATION TO CONGRESS.

In accordance with the authority granted to the Commissioners, they have forwarded petitions to Congress, praying that an appropriation be made for the widening and deepening of the channels leading to the port of Providence, of which a copy may be found in the Appendix to this report. The petitions were presented in the Senate and in the House of Representatives, and referred respectively to the Committee on Commerce of each body. Subsequently, resolutions were offered by Senator Anthony, in the Senate, and Representative Eames, in the House, calling upon the Secretary of War to furnish information as to the needs of commerce in this district, and an estimate of the cost of improving the channels leading to the port of Providence. Said resolutions have been sent by the Secretary of War to the Engineers' Department, and thence forwarded to Gen. G. K. Warren, U. S. Engineer, in charge of this district. Upon receipt of the resolutions, Gen. Warren communicated with this Board, asking for a statement of what was desired. Whereupon the Commissioners prepared and forwarded a statement, of which a copy will be found in the Appendix. The Commissioners have been notified by Gen. Warren that he has forwarded his report to Major-Gen. Humphreys, Chief of Engineers of the United States, and they have held themselves in readiness to proceed to Washington, with such surveys, plans, statistics, etc., as have been collected and prepared for this purpose.

HARBOR LINES.

The Commissioners, having given notice of a time and place for hearing, as required by law, all parties interested in the establishment of a harbor line on the westerly side of Seekonk river, from India street to Bower street, and such a hearing having been had, marked out a suitable harbor line and caused the same to be platted, which they reported to the Governor and Senate, at the May Session of this Assembly, and it was approved by them.

Upon the application of parties at Pawtucket, for authority to extend their wharves where there are now no harbor lines established, the Commissioners, finding that there are wharves already constructed which extend so near to the channel as to make the passage-way for vessels narrower than is desired, deemed it advisable and necessary that suitable harbor lines should be fixed on both sides of the river; they, therefore, marked out a line on the east side from the lower dam to Bass rock, and on the west side of the river from the lower dam to Bensley's Point.

They have also held meetings with the parties interested in the fixing of a harbor line on the west side of Seekonk river, from Bower street to Central or Red bridge.

The Commissioners have caused these lines to be platted, and will soon report them to the Governor and Senate, for their approval.

In their last annual report, the Commissioners stated that, "The harbor line of East Providence is unsuitable, in the opinion of the Commissioners, and they would suggest the repeal of the act establishing it."

A plan is preparing, upon which a new harbor line will be marked out from a point about two hundred feet northerly from Washington bridge and extending to Kettle Point, and also on the westerly side of the river from India street southerly and westerly along the property of the Boston and Providence Railroad Company; and we recommend that action be taken thereon.

Plans will soon be submitted, showing the harbor lines as they now exist on both sides of Providence river, from Crawford street bridge to Fox Point, on the east side, and from Crawford street bridge to Simmons' wharf, on the west side.

Your attention is called to the encroachments which existed when this Commission was appointed.

ENCROACHMENTS.

Since this Commission was established, the following wharves have been reconstructed, and encroachments made beyond the harbor line.

Wharf owned by Alexander Duncan, et al., near the foot of Hay street.

Wharf owned by Daniel E. Day, near the foot of Pine street.

Wharf owned or represented by Richard W. Comstock, near the foot of Power street.

Notices have been sent to these parties, calling their attention to Section 5 of Chapter 611, of the Public Laws; but as the encroachments served simply to bring these structures more nearly into conformity with structures already existing, and not to make a marked encroachment along the shore, no proceedings have as yet been commenced against them. This delay has been suffered that we might call your attention to the whole matter, and we respectfully ask instructions upon the subject.

SURVEYS.

Surveys have been made of Pawtucket river, on the east side, from the lower dam to Bass rock, and on the west side from the lower dam to Bensley's Point; on the westerly side of Seekonk river from Central bridge to Bower street, from Bower street to India street, and from India street to a point near the works of the Union Oil Company; on the east side of Seekonk river from a point about two hundred feet northerly of Washington bridge to Kettle Point, in Providence river, and from Long wharf (as it formerly existed), on the west side of Providence river, to Simmons' wharf.

Where applications have been made for a license for the construction of wharves, surveys have also been made.

DUMPING GROUND.

Applications having been made for a dumping ground, where the city of Providence could deposit material dredged from the harbor, a place known as the "Deep hole," opposite Rumstick Point, was designated. Subsequently, action of the Legislature (see Chapter 623, of the Public Laws) caused the Commissioners to select another place for such dumping ground, and they designated an area opposite Sandy Point, east of Prudence Island, where there is a depth of thirteen to fifteen fathoms of water at low tide, and also an area on the west side of Providence harbor, between Hill's wharf and Sassafras Point, providing said material should be deposited at least six hundred feet inside of the harbor line.

The contract made by the city of Providence for dredging, the present year, provides that all material shall be put on the flats between Hill's wharf and Sassafras Point.

LICENSES.

The following licenses to build wharves have been issued:

1. May 7, James Lawless, Bristol, 250x40 feet, bridge wharf and stone piers.

2. June 13, Warren J. Crosby, Drownville, 250x30 feet, timber wharf, filled with shells.

3. July 28, R. R. Higgins & Co., Bullock's Cove, 80x40 feet, timber dock.

4. October 17, Buel Buckingham, Drownville, 100x25 feet, timber wharf, filled with shells.

5. November 21, Daniel E. Day, Providence, to rebuild about 90 feet of face of wharf, stone wall on pile foundation.

HEARINGS BEFORE THE BOARD IN ADDITION TO THE REGULAR BUSINESS MEETINGS.

Two hearings with the Committee on Harbors of the City Council of Providence and parties interested, as to a proper plan of piers and slips to be constructed on the west side of the harbor below Hill's wharf.

Two hearings with riparian proprietors in relation to fixing harbor line on the west side of Seekonk river, between Bower street and India street.

One hearing with Samuel M. Gray, City Engineer, and Edward S. Philbrick, Civil Engineer of Boston, in the matter of building harbor wall on Seekonk river, above Washington bridge.

Four hearings with Brook street district Committee, in the matter of filling along the westerly side of Seekonk river.

One hearing with Daniel E. Day and John Howe, Civil Engineers, in relation to the harbor line on the west side of Providence river.

One hearing with riparian proprietors in relation to fixing harbor lines on the west side of Seekonk river, between Bower street and Central bridge.

One hearing in relation to the depositing of material in the river above and below the dam in Pawtucket, and also in regard to the emptying of the sewers and wash of the streets into the river below the dam. Complaint was made by those present of the approaches to Washington bridge.

Four hearings with riparian proprietors, in relation to fixing harbor lines on both sides of Pawtucket river; on the east side from the lower dam to Bass rock, and on the west side from the lower dam to Bensley's Point.

Two hearings upon complaint by James Connery, of Bristol, in the matter of an alleged obstruction caused by the erection of a building adjacent to his wharf.

One hearing upon complaint that the Citizens Gas Light Company deposited their refuse coal tar into the river, thereby causing damage to the boats of the Providence Yacht Club.

ADVISORY COUNCIL.

The Commissioners having invited the United States Advisory Council, meetings with them were held August 14th, 15th and 16th, during which time they reviewed the whole work under the Commissioners' care, and fully discussed and considered the subjects appertaining thereto. They also went by steamer and visited many points which were brought to their attention.

In the Appendix to this report will be found copies of the questions asked of the Council, and their very full and able reports in reply.

WORK OF THE UNITED STATES ENGINEER.

By the courtesy of Gen. G. K. Warren, the Board has received a printed copy of his report upon the Government works under his charge in Rhode Island, for the year ending June 30, 1877. The following is a brief summary from the report of the Chief of Engineers in regard to the work upon which Gen. Warren's report in full will be found in the Appendix:—

Pawtucket or Seekonk River, Rhode Island.

No work has been done during the fiscal year, and none will be done this season, unless the shoals become troublesome, or some accidental obstruction occurs.

Bulkhead Rock, Providence River, Rhode Island.

This rock is a dangerous and annoying obstruction to all vessels entering or leaving the port of Providence, drawing more than fourteen feet. It was removed down to fourteen feet, at mean low water, under an appropriation made in 1870. A depth of eighteen feet, at mean low water, is deemed to be necessary, to make which it is estimated will require an appropriation of $5,000.

Newport Harbor, Rhode Island.

With a small balance of the appropriation of March 3, 1875, and the assistance of the officers of the United States Navy, Torpedo Station, and those of the Old Colony Steamboat Company, two large boulders were removed from the channel. These boulders have been struck several times, at extreme low tides, by the large steamboats, and during the last year caused considerable damage. The improvement planned at this place was designed to facilitate business at the port, and not to increase its capacity as a harbor of refuge. With this view, all has been done that is now needed.

Block Island Harbor, Rhode Island.

Work has been commenced on the proposed detached pier, under the appropriation made by the act of August 14, 1876. The funds now available will complete the breakwater designed for the business of the island.

The harbor has become the resort of numbers of fishing vessels, belonging elsewhere, so that at times it is quite filled up. It will undoubtedly be sought by fishermen and ordinary coasters in numbers sufficient to fill a harbor of several times its capacity. The present work was not designed to meet this want. At the close of the season's work a final report will be made, which will include plans and estimates of cost of meeting the probable wants of the future.

Pawcatuck River, Rhode Island and Connecticut.

This improvement, as projected, has been completed, and no further work is now contemplated. The small balance is reserved to remove any small obstruction that may by accident be placed in the channel.

Little Narragansett Bay, Rhode Island and Connecticut.

The improvement projected for this locality, is to open a channel two hundred feet wide and seven and a half feet deep, at mean low water, along the north shore of the bay, by dredging and by removing such rocks as may be found in the way.

The original estimate for the work was $51,000, deducting $5,000 already appropriated, leaves $46,000 still required to complete the work. One-half of this amount could be advantageously expended during the next fiscal year, and would probably suffice to open a channel one hundred feet wide, and thus utilize the improvement of Pawcatuck river, which was completed last year.

We wish to express our high appreciation of the value to this State of the services of the distinguished men who compose the United States Advisory Council: Rear-Admiral Daniel Ammen, U. S. N., Brevet-Major-Gen. G. K. Warren, U. S. A., and Prof. Henry Mitchell, U. S. C. S.

Respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS, } Harbor Commissioners.

APPENDIX.

A.

PETITION TO CONGRESS.

To the Honorable Senate and House of Representatives of the United States in Congress assembled:

The petition of the undersigned, Harbor Commissioners of the State of Rhode Island, etc.,—acting under the authority and on behalf of the said State, respectfully represents—

That the port of Providence is situated at the northern limit of coastwise navigation for vessels that cannot safely pass the dangerous coast of Cape Cod, and has long been an important commercial station. It has good railroad facilities connecting with all parts of New England and the northern States.

The United States has, from time to time, expended money for the improvement of navigation to this port; but, for several years, the sums so expended have been of trifling amount.

The business of the port demands vessels of deeper draught than can pass over a long bar which is in the unimproved part of the harbor, having a least depth of about fourteen feet at mean low water, along the pathway of vessels.

By the excavation of a channel of suitable width and depth through this bar, and the straightening and widening of the channel at minor points, ocean vessels of deep draught may pass from the sea to the harbor, by the eastern passage, a distance of about thirty miles.

In order to furnish a convenient course for vessels of equal draught through the western passage, it would be necessary to cut a channel through a short bar about eight miles below Providence harbor. As there are two safe and commodious entrances to Narragansett Bay, one or the other of which can be made by vessels in a storm from any quarter, it is very desirable that vessels driven to enter by the western passage, should be able to continue, without interruption, on their way to Providence harbor. The western passage is the most important to commerce.

The material of which these bars are composed is believed to be sand and mud, easy of excavation. The city of Providence has expended or appropriated about a hundred thousand dollars for dredging in the harbor since 1870, and the average price per cubic yard, for the last three years, has been less than twelve cents.

The character of the tidal basin is such that channels would probably be permanently maintained at small cost.

Your petitioners, therefore, pray your honorable bodies to make an appropriation for the removal of obstructions, so that vessels of the larger class may find convenient and safe passage to this important harbor.

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS, } Harbor Commissioners.

B.

STATEMENT TO GEN. WARREN.

To Gen. G. K. Warren, Major of Engineers, Newport, R. I.:

SIR:—We have received from you a communication enclosing a resolution of the House of Representatives, of which the following are copies:

[COMMUNICATION.]

ENGINEER'S OFFICE UNITED STATES ARMY,
NEWPORT, R. I., February 8, 1878.

Mr. J. Herbert Shedd, Civil Engineer, President Rhode Island Harbor Commission, Providence, R. I.:

SIR:—I have just received the resolution of the House of Representatives, of which the enclosed is a copy.

The subject has been referred to me by the Chief of Engineers United States Army for a report, with directions to confer with parties representing the interests involved. The matter, you know, has already been considered by us, so that its points are familiar. I wish therefore you would forward to me such report from your honorable board as will represent the question in the light you regard it, to aid me in making my report, and to be transmitted with it to the Chief of Engineers. In its regular course it will probably be transmitted to Congress and printed for the use of the members in passing upon the subject itself.

Yours respectfully,

G. K. WARREN,

Major Engineer, Brevet-Major-General United States Army.

RESOLUTION.

IN THE HOUSE OF REPRESENTATIVES,
February 5, 1878.

On motion of Mr. Eames:

Resolved, That the Secretary of War be and he is hereby directed to communicate to this House as soon as practicable what improvements, if any, are demanded by the interests of commerce for the improvement of navigation to the port of Providence, R. I., based on examinations and surveys already made by the Coast Survey or other departments of the Government, together with the estimated cost of such improvements.

In response to your request we respectfully submit the following:

The improvement of the navigation of this port, for which we ask and which we consider to be urgently demanded by the interests and for the safety of commerce would be accomplished:—

First—By widening and deepening the main channel from Fox Point, above and east of which (on the Providence and Seekonk rivers) are our present wharves, to Field's Point, which is at the entrance to the inner harbor from Narragansett Bay. The distance between the two points by the thread of the channel is about one and one-sixth nautical miles. There is deep water at both the upper and lower ends of this distance, but in the middle a bar exists having at points only fourteen feet depth of water at low tide. A channel suited to this position should be about 1,060 feet in width between its outer banks, 150 feet of which width, in the centre, should be 23 feet in depth at low water, and then of decreasing depths on each side, to the outer banks, where the depth should be 6 feet at low water. This form of channel would meet all the requirements of the case. It would afford good anchorage ground on each side of the central pathway, leaving a free course for the manœuvering or passage of vessels under sail.

Second—Below Field's Point, within the bay, a continuous channel should be secured at least 800 feet in width with a central pathway 23 feet in depth. This part of the work would necessitate the deepening of the natural channel at three points, to wit: Opposite Rocky Point; about half the distance between Gaspee Point and the Pawtuxet beacon, and opposite the village of Pawtuxet. The channel should also be widened between a point nearly opposite Pawtuxet village and Field's Point.

We should then have an unobstructed passage-way from the open sea to our docks for such heavy draught foreign and coast-wise vessels and for such numbers of all draughts as would certainly seek our harbor if so improved.

As the streams emptying into the harbor are not of such size or character as to bring down any considerable amount of silt, it is quite probable that if the channel is once properly improved only a small annual outlay will be required to preserve its condition. The estimated volume of material to be removed between Fox Point and Field's Point, to secure the desired channel, is about 2,250,000 cubic yards, measured in bank; for the work in the bay the amount would be about 1,204,510 cubic yards.

As will hereafter appear by the contract prices for similar work for the city, there are few or no harbors where dredging can be more cheaply done; and, as the proposed improvement consists mainly of that kind of work, it follows that, at comparatively small cost, the chief obstacle to our advancement in commercial prosperity may be removed.

We feel assured that the contemplated dredging can be done at the rate of seven cubic yards for $1.00.

If this work is done, a continuous channel of about thirty miles in length, of twenty-three feet depth of water, from the sea to this port, may be secured.

The city of Providence has peculiar advantages of location as an importing and exporting center. Its outer harbor is Narragansett Bay, through one of the two unobstructed passages to which it can be entered by the largest vessels that float, in any wind, at any time, without a pilot; and it is never obstructed by ice to prevent making a good harbor. It is completely land-locked, and has about seventy square miles of anchorage, where the entire shipping of all the ports of the United States could ride out any storm in safety.

The harbor proper is an interior basin at the head of the bay, having an area of about 700 acres, with a channel leading up to the wharves. This channel is obstructed by a bar, having only fourteen feet depth in places at low water, as already stated.

The city of Providence is the second in size in New England, and the sixteenth in the United States. It now contains a population of about 100,000, having made a very rapid growth in the last ten years. It is the most northerly important terminus of safe and convenient navigation from southern ports, lying, as it does, about thirty miles into the interior of New England, and having direct railroad communication with all parts of those States and the Canadas, and, by tapping the roads leading west, with the grain producing States.

It is the radiating center of supplies of raw material, as also the market for an immense aggregate of manufacturing industries located immediately around it and mainly developed and sustained by the water power of three streams. The leading manufactures are cotton and woolen goods, machinery, arms, etc., in which there are about fifty million dollars invested capital.

Of print cloths, there were reported sold here in 1877, a year of great depression in business, and, therefore, not a fair showing, 2,742,330 pieces. The average annual sales during the previous ten years amounts to 4,614,733 pieces.

The total reported receipts of cotton in this market, by all routes, during the year 1877, were 234,532 bales, which is 18,746 bales less than the average during the previous six years.

The total reported receipts of wool of all grades, by all routes, during the year, were 65,333 bales and sacks; the average during the previous six years being 93,983 bales and sacks per annum.

By the last census of Rhode Island, it appears that our bleacheries and print works consumed about 6,000 tons of supplies of foreign growth or manufacture; but there was difficulty in obtaining the facts, and the general belief is that these figures should be largely increased.

Providence is also the chief coal port of New England. The total reported tonnage of coal during the year 1877 was 642,480 tons, of which 4,960 tons were foreign; the average per annum during the previous six years was 580,587 tons, the foreign average being 5,768 tons.

The total reported receipts of flour during 1877 were 324,539 barrels, which is 38,477 barrels more than the average annual receipts of the previous six years.

This, therefore, to the extent of our present transportation facilities, is an important receiving and distributing point for direct importations and productions for export. For coastwise traffic it is already the leading port in New England, and with our harbor so improved that ocean steamers and coastwise vessels of the heaviest draught could reach our wharves, we should have unsurpassed facilities for becoming a commercial, as we already are a manufacturing center.

More coastwise vessels now enter this bay and port than any other port in New England. Some of these of large draught of water, like the Philadelphia, Norfolk and Baltimore (freight) steamers, are at times compelled to wait hours for the full tide to enable them to cross the bar and reach the inner harbor.

Many others are effectually barred from entering the port at all on account of the insufficient depth of water in some parts of the channel; the inconvenient and expensive result of which is that a considerable part of the freight consigned to our merchants and manufacturers, besides that which would naturally come to this port in transit to interior points, must first be delivered in New York or Boston and then reshipped by rail to this port. One of the onerous features of this process is that the port charges elsewhere are about twice as much as they are here; and this is one considerable item which counts with ship owners in favor of this as a port of entry.

A pressing need of our present commerce is more anchorage room, already large, to allow the channel to be kept free for the passage of vessels. As many as seventy to seventy-five vessels have come into the harbor in an afternoon, for all of which, with those already at anchor, there is not sufficient room. The result is a frequent blockading of the channel against the safe passage of vessels in and out of the harbor. Regular lines of passenger and freight steamers run daily between this and other ports, and in their passage through the channel much delay and danger sometimes result from the encroachments of anchored vessels lapping out over their course. This trouble is increased during the summer months, when excursion steamers, loaded with passengers, are passing in and out almost hourly.

The State does not ask that its maritime facilities shall be developed entirely at the expense of the United States Government. Its appreciation of the importance of preserving and improving the advantages it already possesses, is shown by the expenditures which have been made to that end. The government of the city of Providence annually appropriates from $10,000 to $15,000 for the improvement of the harbor. A large amount of dredging has already been done in and about the upper part of the channel with the money thus appropriated, and sums paid by individuals; and now there is much more water in the harbor proper, and around the docks, than on the bars below.

During the last eight years, $89,380.10 have been expended by the city for dredging alone, and for surveys, plats, etc., $2,474.00 more. This work has been done under very favorable conditions; the contract of last year for dredging about 168,000 cubic yards having been made at nine cents per cubic yard. The amount appropriated by the city for the current year is $15,000, and a contract for the dredging has been executed at thirteen cents per cubic yard, requiring the material to be carried on trestle-work to fill flats belonging to the city.

The city has also nearly completed the removal, at a cost of $60,000, of about 260,000 cubic yards of mud from the "Cove Basin," so called, at the head of Providence river.

The chairman of the Harbor Committee of the City Council has submitted a statement relative to the city's operations in the harbor, of which the following is a copy:

PROVIDENCE, January 22, 1878.

J. Herbert Shedd, Esq., Chairman of the State Board of Harbor Commissioners:

SIR:—In reply to yours of the 10th instant, I would say that for many years the city has expended considerable sums upon dredging in the harbor, as will appear in the enclosed tabular statement. Our citizens and our City Government fully realize the imperative necessity of increasing our harbor facilities, and a judicious and comprehensive plan for harbor improvement will assuredly receive cordial support.

If only work could be done in the river and bay, below the point where the city could be asked to expend money, we might hope that our harbor would receive and our wharves accommodate the largest vessels.

The following statement of money paid and work done on the harbor since 1870 is submitted and made a part of this communication:

For the year ending Oct. 1.	Salary of Harbor Master.	Services for superintendence, etc.	Surveys, plats, etc.	Amount paid for dredging.
1870........... ...	$1,100 00	$763 00	....	$16,583 10
1871..............	1,100 00	321 00	....	9,532 81
1872..............	1,150 00	....	....	9,940 56
1873..............	1,300 00	....	....	5,621 13
1874..............	1,300 00	....	$2,000 00	14,828 21
1875..............	1,300 00	....	....	10,016 28
1876..............	1,633 33	....	....	11,495 79
1877..............	1,800 00	535 00	474 00	11,362 22
	$10,683 33	$1,619 00	$2,474 00	$89,380 10

In 1876 the appropriation for dredging the harbor was $11,500. The contract for dredging was given to S. H. Hammond at thirteen cents per cubic yard.

In 1877 the appropriation was $12,500. The contract for dredging was awarded to "Providence Dredging Company" at nine cents per cubic yard.

For 1878 the appropriation is $15,000, and contract for dredging awarded to Thomas Potter at thirteen cents per cubic yard.

These low prices have been obtained notwithstanding the fact that there has been extra trouble to the contractor in disposing of the material. Last year about half the mud was towed sixteen miles to a dumping ground, and for the year to come the price includes the transferring the material by cars on trestle to ground too high to be reached in scows. This is required in order to develop wharf property.

Very respectfully yours,

ARTHUR F. DEXTER,
Chairman for Committee on Harbor.

We insert a copy of preamble and resolutions passed by the Providence Board of Trade.

The following *preamble* and *resolutions* were read and unanimously adopted at the *annual meeting* of the *Providence Board* of *Trade* of the *city* of *Providence, R. I.*, held *January* 9, 1878.

COPY.

WHEREAS, This city is situated at the head of Providence river, affording a broad, safe and natural approach to a point about thirty miles inland, from which a large portion of the New England States may be commercially reached; and

WHEREAS, Much shipping is prevented from coming to this port, on account of the shoal channels leading to the harbor, notwithstanding our City Government has already expended considerable sums of money in widening and deepening the channels of the harbor; therefore

Resolved, That in the opinion of this Board it is desirable and necessary that steps be taken to procure aid from the United States Government to enable the improvement to be made so that the natural facilities of this harbor may be properly developed and increased

Resolved, That the President of this Board be and he is hereby appointed a committee to confer with the State Board of Harbor Commissioners and is requested to coöperate with said Board in urging upon the United States Government the importance of the work and procuring the necessary aid therefor.

PROVIDENCE, January 29, 1878.

I hereby certify the foregoing to be a *true copy* and *record*.

F. P. LITTLE,
Secretary.

In response to another resolution passed by the Board of Trade, the following report of a committee was presented to that body.

Resolved, That the President of this Board be authorized to appoint a committee to ascertain the amount of foreign and domestic goods annually brought into this district.

Your Committee were notified of their appointment on the 22d ult. They were called together immediately, and have held several meetings to consider the business confided to them.

The difficulties in the way of obtaining such information as is desired are many. The want of time precludes the possibility of issuing circulars to our merchants and manufacturers, requesting such information as would enable us to estimate accurately the amount of material required in their business, and had the time been sufficient, the reluctance of many of our manufacturers to give such information, would have rendered a report thus obtained inaccurate.

The last census of Rhode Island, taken under the charge of a most faithful and efficient superintendent, gives the capital employed in manufactures, *i. e.*, value of real estate and machinery, as $49,942,871; of raw material used, $76,715,970; of products, $126,659,875.

Under the head of special manufactures, we find that there were reported to have been used in print works and bleacheries, about 6,000 tons of materials of foreign growth or manufacture. From information received from other sources, the last item is believed to be much too small, and the same discrepancy may exist in other figures.

So far we have spoken only of supplies required in our manufactures. There is no possible means of obtaining an account of supplies required for all other branches of industry for a population of 258,239 persons.

Were it possible to obtain ever so correct an account of the wants of the people of our own city and State, we should still be far short of the information of which we are in search.

Providence harbor is the natural source of supply, and the natural outlet for all of the country lying east of the Connecticut river north to the Canada border, and west of Boston; in fact, coming from the south, Providence is nearer, by steam, by twenty-four hours than the harbor of Boston; and when we consider the dangerous navigation around Cape Cod, we are led to believe that with sufficient depth of water in our bay and harbor, the Boston lines from the south would find it for their advantage to make Providence the terminus of their voyage, and transfer by rail such parts of their cargoes as may be destined for Boston.

With a view to estimating the number of tons of merchandise that is annually going to and from and through this city, we have requested from our several railroad companies and from the New York, Philadelphia and Norfolk lines of steamers, an account of the number of tons of merchandise transported by them during the past year.

The tonnage on the railroads is given in total, as there is no means of ascertaining how much may go from point to point on the roads without touching this city; but, when we consider that in this statement there is no account taken of the amount carried by the smaller lines of steamboats, by sailing vessels and by teams, we may not form a very inaccurate idea of the business of this port, even in dull times, and when the bars in our bay prevent us from receiving a very large part of the business that the position of our city would otherwise give us.

The accounts received from the railroads and steamboats are as follows, viz:—

Providence and Springfield	37,987
Providence, Warren and Bristol	47,036
Providence, Hartford and Fishkill	296,681
Providence and Stonington	226,945
Boston and Providence	631,850
Providence and Worcester	641,135

Winsor Line to Philadelphia	48,254
Providence, Norfolk and Baltimore	105,600
Providence and Stonington S. S. Co. (boat direct)	375,000
Total Tons	2,410,488

The records of the Custom House show that during the past year there have been 123 foreign and 5,520 domestic arrivals; that the value of imports were $466,868; that there were brought by water, 201,699 bales of cotton, 37,745 bales of wool, 60,362 barrels of flour, 685,336 bushels of grain, and 642,480 tons of coal.

It is estimated by competent authority that the wholesale grocery business of this city amounts to $11,000,000 per annum, and that of this amount $7,300,000 is in goods of foreign growth. The trade in drugs and chemicals, which is very largely in merchandise of foreign growth or manufacture, is estimated at about $5,000,000 per annum.

The domestic importations of Providence by railroad and by water for 1877, are given as follows:

234,532 bales of cotton.
324,539 barrels of flour.
1,549,096 bushels of corn.
586,905 bushels of oats.
642,480 tons of coal.

Respectfully submitted,

JAMES SHAW, Jr.,
GEORGE W. WHITFORD,
BENJAMIN W. PERSONS.

As illustrating the delays resulting from the shallowness of the water on the bar, we insert the following copy of a letter received from the agent of one of our principal steamship lines:

Providence, Norfolk and Baltimore Steamship Line.
P. O. Lock Box No. 482. E. H. Rockwell, Agent.

Providence, R. I., Feb. 14, 1878.

J. Herbert Shedd, Esq., Chairman of the Harbor Commissioners:

Dear Sir:—I beg and desire to call your attention to the fact that, in the year 1873, the Merchants and Miners Transportation Co. of Baltimore, Md., inaugurated a line of steamships between Baltimore, Norfolk and Providence, and styled it the "Providence, Norfolk and Baltimore Steamship Line." Since this line was set in motion, owing to the great draught of water of our steamers, we have met with very serious delays on account of the depth of water in our harbor. The steamers of this line, when full freighted, draw eighteen and twenty feet of water, and have touched bottom in midway of channel, and dragged the bottom for long distances; and when we have had strong northwest winds we experience very much more delay.

If our steamers arrive on an ebbing tide, of two or three hours duration, and ground, they are obliged to so remain until the full flood tide makes again, causing the loss of valuable time—from six to eight hours—which is exceedingly annoying to our patrons and ourselves.

I will here state that the Merchants and Miners Transportation Co. also run a line of steamers between Baltimore, Norfolk and Boston *via* Cape Cod, and I have often advocated to them of their making the terminus of the Boston steamers at Providence, and connect with Boston by railroad, but our company has always contended that it was not practicable to do so with their largest steamers, on account of the shallowness of the water in our harbor; but have intimated to me that if harbor facilities were such at Providence that no delays would occur on account of depth of water, and the steamers could arrive and depart at any time of tide, that, ultimately, the terminus of the Boston line would be established at Providence. This line is an important one for the city of Providence, running as it does direct to the South, connecting at Norfolk, Va., with the Virginia and Tennessee Air Line and Seaboard and Roanoke Railroads, for all points South; and at Baltimore (Locust Point), Md., with the Great Baltimore and Ohio Railroad, for all points West, North and Southwest. I trust that some special action will be taken by the State this present year to improve the navigable waters of our beautiful "Narragansett."

Very respectfully yours,

E. H. ROCKWELL, Agent,
Prov., N. & B. S. S. Line.

We have been kindly furnished by Gen. James Shaw, Jr., Collector of this Port, with the following statistical table:

COMMERCIAL STATISTICS OF PROVIDENCE,

1871 TO 1877.

	1871.	1872.	1873.	1874.	1875.	1876.	1877.	
Foreign arrivals.....	205	182	175	170	91	90	123	
Value of imports.....	$652,281	$780,616	$818,323	$412,698	$553,768	$288,454	$466,868	Foreign value in gold.
Coastwise arrivals...	5,808	6,542	6,952	4,665	6,873	5,826	5,520	
BUNGING.								
Bales of cotton......	182,598	198,825	299,864	254,235	178,446	218,267	201,699	
Bales of wool........	55,187	43,540	149,561	47,278	87,891	89,904	87,745	
Barrels of flour......	145,875	181,713	171,048	261,920	161,486	88,682	60,862	
Bushels of grain.....	751,558	886,058	876,617	942,290	822,009	716,830	685,334	
Tons of coal.........	548,669	699,188	709,784	600,886	691,847	610,859	642,480	
TONNAGE.								
Vessels...	92	85	129	123	128	131	131	
Tons................	21,090	19,115	22,489	25,977	34,107	35,107	36,611	

Registered in Providence.

JAMES SHAW, Jr.,
Collector.

All of which is respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

C.

ADVISORY COUNCIL.

QUESTIONS PROPOSED BY THE BOARD OF HARBOR COMMISSIONERS TO THE UNITED STATES ADVISORY COUNCIL, AND THEIR REPLY.

Commodore Daniel Ammen, Chief of Bureau of Navigation, Chairman of U. S. Advisory Council upon the Public Waters of Rhode Island, Washington, D. C.:

DEAR SIR:—The Board of Harbor Commissioners for the State of Rhode Island, desire the advice of your Board upon the following subjects:

1. What would you propose as to the general improvement of the harbor?

2. What width, depth and cross-section of channel should be sought in order to best accommodate the shipping likely to come to these waters?

3. Has any change been made in the tidal flow of the Seekonk river to the injury of Providence Harbor, and what changes in the harbor would be likely to follow encroachments upon this basin?

4. May any change be made to improve the harbor by restoration of tidal flow, and could such restoration be effected by a rebuilding of the bridges?

5. Will the Council indicate what studies or surveys may be involved in obtaining specific information?

6. What general course should be pursued in considering the establishment of harbor lines, in view of the necessary encroachment upon public waters, and the probable effect upon tidal currents, and the form and depth of channels?

7. What course shall be pursued in order to most effectually bring before Congress the necessity for government aid in improving the channels and approaches to Providence Harbor?

8. Will the Council suggest from time to time, such information as may be deemed to be of service to this Board in preserving and improving the navigable waters of the State?

Very respectfully, your obedient servants,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS, } Harbor Commissioners.

PROVIDENCE, November 5, 1877.

NAVY DEPARTMENT, WASHINGTON, D. C.,
December 17, 1877.

To the Honorable Board of Harbor Commissioners for the State of Rhode Island:

GENTLEMEN:—In considering the interrogatories contained in your communication of November 5th, we have endeavored by a careful inspection of the original surveys of Providence Harbor, made by the U. S. Engineers, and by the U. S. Coast Survey, to give our personal knowledge of the locality such precision as would enable us to make the practical suggestions which seem called for; but it is proper to state that questions of so general a character as those you propound—while admitting, designedly, no doubt, of great latitude in reply, make our task somewhat difficult. Nevertheless, we recognize in your action an indication of your very earnest sense of the importance of the work before you; and we offer our suggestions as an introduction to this work, in which we propose to assist you hereafter to develop *the details*.

DESCRIPTION OF PROVIDENCE HARBOR.

From a physical point of view, the harbor of Providence is an interior basin of Narragansett Bay, and comprises the water space between Field's Point and the dam at Pawtucket, with the addition of Providence River, as far up as the "Cove"—a total water space of 1700 acres, in round numbers. For convenience of reference we shall divide this space into three compartments, viz: the Seekonk Basin, having an area of about 900 acres, between the before mentioned dam and the draw-bridges at India Point; the Providence River, from the head of tide water to the Point Street Draw Bridge, about 50 acres, and the harbor proper, from the bridges to Field's Point, about 700 acres, omitting lagoons.

The harbor proper is a thin sheet of water, covering a vast accumulation of silt or mud, through which winds a narrow channel, that the chart shows to be a continuation of that which issues from the Seekonk Basin.

This channel enlarges as we follow it down towards its outlet upon the bay, and the mind almost instinctively assumes that it has been hollowed out, or rather maintained by a stream, whose volume augments from point to point; and in the absence of tributary land waters, we naturally look to the tides for an explanation — recognizing as axiomatic, the general rule that the section of a tidal channel through an alluvial bottom, should vary in area with the service it is called upon to perform as an aqueduct. This service, were the tides at different points synchronous and of uniform *effective range*, would vary almost directly as the superficial areas covered. For the case in question, the requisite conditions are so nearly fulfilled that comparisons of superficial areas and vertical cross-sections ought to be conclusive.

Selecting the two terminal sections, as near as proper regard to the definition of the channel will permit, we have the space above Bald Point, 950 acres, terminating in a vertical cross-section of 13,000 square feet, and the area of the space above Field's Point, 1,700 acres (including lagoons), terminating in a vertical cross-section of nearly 24,000 square feet; in the first case the ratio of our figures is 1.13, in the second case, 1.14. Intermediate sections are difficult of comparison, because the channel way is ill defined; but such comparisons as can be made offer the same general testimony, and we express without doubt the conclusion that: *The main channel of Providence harbor is maintained by the tides;* and as a corrollary, assert that: *An increase or diminution of the tidal area of the basins would sooner or later be followed by a corresponding increase or decrease of the channel below.*

A tide of four and a half feet range visits Providence harbor, and the *effective volumes*—those for the hours of greatest filling and draining—are at the entrance section (Field's Point), eighty-nine millions of cubic feet on the flood, and ninety-six millions on the ebb; the former excluding or "*backing up*" three and a half millions of land water, and the latter including or bearing off the river supply.

Leaving the strictly physical point of view, we observe from the surveys that the harbor proper, although it presents a superficial area of 750 acres, affords for anchorage and manœuvering room for ordinary vessels only 138 acres at low tide.

By ordinary vessels, in this statement, we refer to those drawing only 12 feet when laden. The same area, 138 acres, is afforded for the manœuvering of good sized vessels (those drawing 16 to 17 feet,) at ordinary high water; but such vessels can find only 67 acres for anchorage, without taking the ground, at low tide.

Practically, the depth of a channel is that of its shallowest pass, and applying this rule, the depth of the main channel of Providence harbor is 14 feet at low water and 18¼ feet at high. While there is no generally recognized definition of a *ship channel*, no one would think of placing the requisite depth of a channel so designated at the figures just given. We are, therefore, constrained to state that:

The harbor of Providence has no ship channel. There is no harbor, perhaps, in the country where dredging can be done at less cost; and since there is little silt naturally brought down by the inconsiderable fresh water streams, it is probable that the channel, once deepened effectually, could be maintained at a very small annual expenditure in the average.

Having indicated in the foregoing the premises upon which our answers to you should be based, we shall proceed to consider your questions in detail:

1. We recommend the enlargement of the main channel of the harbor, and an improvement of the passage ways through the bridges at the outlet of the Seekonk Basin.

2. In a port like Providence, employed for miscellaneous commerce, the greatest good to the greatest number is to be secured by a channel of eighteen feet depth at low tide.

In order, however, not to exclude vessels of greater draught, we recommend that the channel should have a central pathway of twenty-three feet depth, one hundred and fifty feet wide.

The form of channel that would meet these requirements and have the most permanent slopes, would have the following widths naturally between its contours, in light alluvium:

23 feet depth	150 feet wide.
20 "	600 "
18 "	725 "
12 "	940 "
Grade "	1060 "

We recommend that this channel should be carried from the city to Field's Point, following generally the present channel below Fox Point, and using the above table as a guide, as far as possible, for computing the amount of material to be removed, (and not as a convenient plan of dredging,) we find from the original hydrographic sheet of the Coast Survey ("1326 A.") executed in 1874, that the necessary dredging would then have been two and a quarter millions of cubic yards, *bank measurement.*

The average length of vessels likely to seek this harbor if improved, may be set down at 150 feet, and these, with average draught of eighteen feet, would require fifty-four feet of cable, giving for radius of swing room 202 feet. These vessels, anchored most carefully on both sides of the channel proposed, would leave 321 feet gangway for the passage of other vessels. If anchored with only the ordinary care (but still under supervision of a harbor master,) the width of the gangway would sometimes not exceed 150 feet. It is assumed that so few vessels of extraordinary draught would be in port at the same time, that the harbor master could so arrange them as to avoid having any two of them in the same section. It is proper to regard the vessels as lying transversely to the direction of the channel, because during the season when the largest fleet visits this port, winds from the W. S. W. and S. W. prevail.

In providing for anchorage room on either side of the gangway, rather than excavating a special basin for anchorage, it has been borne in mind that the whole channel, in the absence of vessels at anchor, will be useful for the passage of vessels under sail, and that this channel, traversed by tidal currents, will be less likely to freeze up than a sheltered basin, or more easily broken out when frozen.

3. We have no data from which to conclude that there has been any change in the range of the tide in the Seekonk river, and while the violence of the currents under the India Point bridges shows that the propagation of the tide has been, in a measure, interrupted, we are unable to state that this interruption lessens the flow through the channels, above and below, at time of maximum velocity (soon after half tide), when the effective scour occurs. This question is worthy of study, and we recommend comparative gaugings.

As things are now, an encroachment upon any of the tidal reservoirs will ultimately reduce the channels below by lessening the flow through them. Should such channels, however, be artificially increased in section, their rate of decline will be nearly independent of such encroachment until the present conditions are restored.

Since it would be eminently just and proper, under the *present* circumstances, to require of all who encroach upon tide water to provide by prepayment for the injury to the channels below, it is recommended that provision for maintaining the depth in any channel, hereafter dredged, should be made upon the same basis.

4. We recommend that such changes be made in the piers and bays of the bridges as the study indicated in No. 3 may show to be necessary to restore, so far as may be, the natural and orderly flow of the tides, not only because more useful scouring action may be induced, but because the present violent flux and reflux make the passage of vessels inconvenient, and sometimes injurious.

We are satisfied that the piers, by their *angular resistance*, and as *abrupt obstacles*, as well as inadequate water spaces, retard the tide unduly.

5. Not only in the neighborhood of the bridges, but throughout those portions of the channels where artificial structures, or unyielding banks, appear on one or both sides, the streams should be gauged to ascertain where these streams are out of register with the avenues they traverse. Slacks and eddies along the borders of such streams will indicate where such studies should be most carefully made, in view of occupation of territory for commercial purposes. Studies of this kind yield results which suggest their own application, and leave less to the uncertain judgments of men.

6. The channels of Providence harbor must ultimately be preserved by dredging, if the commerce of the port continues to increase; and if provision is made, as suggested in our reply to No. 3, for creating a harbor fund, liberal provision may be made for the occupation of the frontage, reserving in all cases an ample channel way, with allowances for anchorage and winding room.

For the location of every portion of the harbor line a reason should be stated; or should no adequate reason exist in any particular case, this should be frankly acknowledged, in order that a change may be made wherever the wants of commerce demand, without disturbing public confidence in the *permanence* of the system as a whole.

The element of permanence is so important, as affecting the value of riparian privileges, that every endeavor should be made to give a final solution to the problem at each point, and to this end a physical reason is the best because most *permanent.*

The studies indicated in Nos. 4 and 5, are among the requisites for the proper location of harbor lines, limiting the undue extension of wharves, &c. It is very often the case that parties on opposite sides of a basin or channel, can present equal claims, based on commercial wants, for the privileges of extension, but that both cannot be granted without impairing the navigable facilities of a public thoroughfare. In a case of this kind your Board will find that careful gaugings of the water at rest, or in motion, will enable you to determine lines which shall represent equal displacements or diversions of the streams, or balance other physical elements, and thus you will be able to secure, as a compromise of all lines, an equitable adjustment.

The above are designed to be the general hints and suggestions which your question seems to call for, but we shall be ready whenever you have arranged a scheme of lines to go over the ground, examine the data upon which your reasons are based, and weigh all the arguments with you.

7. There should be prepared a full statement of the present obstructions or deficiencies as developed by past experience, and the public importance of relief and improvement of this as a national harbor should be set forth.

You will best commend any project to the attention of Congress by indicating your willingness to assume a share of the burden, either by contributing towards the work directly, or by providing for the maintenance of the improvement, as we have heretofore suggested.

8. The Board, if advised of the progress of the studies indicated and the improvements as they progress, will be most happy to yield any assistance in its power.

Very respectfully, your obedient servants,

DANIEL AMMEN, Chief of Bureau of Navigation.
HENRY MITCHELL, U. S. Coast Survey.

NEWPORT, R. I., December 22, 1877.

I will make a special communication to the Honorable Board of Harbor Commissioners, noting what part of the above I agree with, and what I do not.

Very respectfully,
G. K. WARREN, U. S. Engineer Corps.

BUREAU OF NAVIGATION, NAVY DEPARTMENT,
WASHINGTON, December 28, 1877.

To the Honorable Board of Harbor Commissioners of the State of Rhode Island:

GENTLEMEN: I have the honor to forward the reply of Gen. G. K. Warren, U. S. Engineers, to the questions given the Board by you. In my belief, your honorable body will derive advantage from whatever differences of opinion may exist when clearly and fully expressed, as is the case in the enclosed paper.

It indicates, on the part of our co-laborer, a careful study and full knowledge of the localities, and doubtless will receive, as it should, that careful consideration to which it is justly entitled.

I have the honor to be,

Very respectfully, your obedient servant,

DANIEL AMMEN, Chief of Bureau of Navigation.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 22, 1877.

To the Honorable Board of Harbor Commissioners of the State of Rhode Island:

GENTLEMEN: I was unable to attend the meeting of the U. S. Advisory Council this month, to consider the questions and prepare the answers which you desired of us. I, therefore, sent my proposed answers without the benefit of consultation with my co-members, expressed briefly. To some of these answers as thus made by me, my colleagues have made important additions, which I adopt. But in the matter of natural physical influences, I differ so much with them that I cannot subscribe to the part they have presented preliminary to the answers they have given, and this difference also prevents my agreeing with them in certain of the answers. I therefore make this special communication.

As a preliminary to considering the question of Providence harbor, I will say briefly, that in my judgment its improvement is involved in no problem of physical laws, and that it is simply a question of capacity for commerce and convenience of navigation. Points to be cut off; crooked places to be made straight; narrow places widened; shoals to be removed, and all by artificial means, and to be maintained in the same way. An improvement carried on, on such principles will be comprehended by every practical man of good judgment, and every one will see the reason and necessity of any proposed work. The consideration of physical laws lead to prolonged investigations and involved conclusions, that few can understand or submit to, and should be avoided unless the question has no other solution. They delay practical operations and consume time and money. I do not mean that plain natural laws should be disregarded, nor do I wish to restrict any one in exhausting the subject, in any direction he thinks necessary, who has a voice in deciding the questions that arise. I but give the advice upon which I would act myself.

My answers to the eight questions are as follows:

Answer to questions 1 and 2. I agree with the other members of our Council.

Answer to question 3. This is really two questions, but the answer of my colleagues makes it three. They state there "is no data from which to conclude that there has been any change in the range of the tide in the Seekonk river." I think there is, and that the obstructions at India Point have had the injurious effect of retarding the flood tide wave, and diminishing its useful effect above. Your honorable board, however, as I read it, does not ask the question. There may be some doubt on this point, however, as the use of the words Providence harbor has a different signification in the questions, and in the preliminary remarks of my co-members.

The question: "Has there been any change in the Seekonk river to the injury of Providence harbor? I answer, I do not know of any. To the second part of the question put, I think any judicious filling of the Seekonk basin could be made to a large extent without injuring Providence harbor, as it is proposed to improve it.

Answer to question 4. I would use every effort to have the bridges at India Point rebuilt, and the passage made as wide and straight, and free from piers as practicable, for the convenience of navigation. The way to do this requires no study for my guidance. In engineering there is no matter better settled than how to do this. The opposition will be the resistance of adverse interests. "Vested nuisances" they may be called.

Answer to question 5. This is implied in answers already given.

Answer to question 6. I agree with my co-members, excepting the last sentence relating to "physical reason."

Answer to questions 7 and 8. I agree with my co-members.

Very respectfully, your obedient servant,

G. K. WARREN, U. S. Engineer Corps,
Member of Advisory Council.

D.

ABSTRACT OF REPORT OF GEN. G. K. WARREN, TO CHIEF OF U. S. ENGINEERS, FOR 1877.

B—6.

Pawtucket, or Seekonk River, Rhode Island.

No work has been done in this river during the past fiscal year. The remainder of the last appropriation is reserved to deepen certain shoals which are re-forming, or for the removal of any accidental obstruction which may take place.

For a history of this work, see Annual Reports of the Chief of Engineers for 1874, Part II., page 227, and for 1876, Part I., page 207.

Pawtucket river is in the Providence collection district, and that place is the nearest port of entry.

The amount of revenue collected there during the fiscal year ending June 30, 1876, was $182,352.57.

MONEY STATEMENT.

July 1, 1876, amount available	$1,594 61
July 1, 1877, amount expended during fiscal year	83 33
July 1, 1877, amount available	1,511 28

B—7.

Bulkhead Rock, Providence River, Rhode Island.

The removal of the rock to eighteen feet depth, at mean low water, is of importance to vessels entering or leaving the harbor of Providence.

Under the appropriation of $2,500, made in 1870, it was removed to fourteen feet at mean low water, but this depth is not enough.

Providence river is in the Providence collection district. Providence is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1876, was $182,352.57.

MONEY STATEMENT.

July 1, 1876, amount available	$74 98
July 1, 1877, amount available	74 98
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1879	5,000 00

B—8.

Newport Harbor, Rhode Island.

The improvement of this harbor was essentially completed last year, as far as designed. (See Annual Report of the Chief of Engineers for 1873, pages 964–967.)

The small amount on hand at the beginning of the fiscal year had been reserved for contingencies, and with it, we, assisted by the Naval Officers of the United States Torpedo Station, and by the Old Colony Steamboat Company, removed a large bowlder from the channel, between the south end of Goat Island and Lime Rock Light. This bowlder had but eleven feet on it at mean low water, and in extraordinary low run of tides, not more than nine feet.

The steamboats have occasionally struck something in coming into the harbor, but it being at night and the vessels never sticking, the location of the obstruction and its nature had been a matter of conjecture. Last winter, the large steamboat Bristol, in entering the harbor, at time of very low water, struck on it so hard as to tear off a large amount of copper. The divers employed to examine her bottom, reported that she must have struck a rock or an anchor. We then swept this part of the channel with two boats and a weighted line, between them. This line, after repeated trials caught, and a diver was sent down, and reported a bowlder about twelve feet by thirteen feet, and five feet above the bed. He brought up several pieces of copper, similar to that on the Bristol. The rock was then shaken to pieces with charges of dynamite, by Prof. W. N. Hill, of the Torpedo Station. The pieces were raised so as to leave a depth of fifteen feet at mean low water. In sweeping for this rock, a can buoy was found, which was raised and returned to the Light House Department.

Another large bowlder, having but nine feet on it at mean low water, where the depth around it was eleven feet, was removed from the inner harbor. This rock had to be broken with dynamite, like the other, before the schooner employed could raise it.

The improvement of this harbor, has been made by dredging a channel along the new harbor line, with an approach 250 feet wide in the middle part, and one fifty feet wide at the north side. Along the harbor line, the width varies from eighty-five to one hundred and five feet, and the depth, from twelve feet in the middle portion, to ten feet at the ends. Wharf-owners have now the opportunity of dredging from the new channel in to their wharves, or extending the latter out to the channel.

A jetty was also built at the south end of Goat Island, which has served effectually to prevent the shore sands and gravel from drifting into the inner harbor.

No further improvement of the harbor is needed at present for its local business, except what should be done by private parties.

The whole outer shore of Goat Island should, however, be protected by short jetties or by a sea wall.

Newport is in the Newport collection district, and is a port of entry. The amount of revenue collected during the fiscal year ending June 30, 1876, was $258.20.

MONEY STATEMENT.

July 1, 1876, amount available	$954 06
July 1, 1877, amount expended during fiscal year	923 92
July 1, 1877, amount available	30 14

B—9.

Block Island Harbor, Rhode Island.

At the beginning of the present fiscal year, the amount of funds available for this work ($22,447.70) was too small to commence the building of the detached pier, which, unless completed, would prove a dangerous obstruction.

By act of Congress, approved August 14, 1876, $40,000 was appropriated, but this was not made available until February 7, 1877.

Advertisements were issued February 22, inviting proposals for furnishing granite for continuing the work. On the 22d of March the following proposals were received:

Abstract of Proposals received at the Engineer Office United States Army, Newport, Rhode Island, March 22, 1877, *at* 10 *A. M., for furnishing riprap granite for Block Island Breakwater.*

Number.	NAME AND ADDRESS OF BIDDER.	Price per ton, 2,240 lbs.	Commence	Complete	$45,000 will pay for tons.
1	Patrick Harrington & Co., Groton, Conn.	$1.29	May 1, 1877..	Nov. 30, 1877	34,573
2	Simeon A. Chapman and A. D. Cook, Groton, Conn.	1.43	May 1, 1877..	Nov. 30, 1877	31,648
3	F. H. Ingerson and W. H. Molthrop, New London, Conn...	1.55	Apr. 15, 1877.	Nov. 30, 1877	29,032
4	Francis H. Smith, New York City*	1.69	May 1, 1877..	Nov. 30, 1877	26,627
5	Ballou & Sylvester, Boston, Mass	1.69	May 1, 1877..	Nov. 30, 1877	26,627
6	Samuel Dale and Levi Moses, Springfield, Mass	1.69	May 1, 1877..	Nov. 30, 1877	26,627
7	Beattie & Dresser, Guilford, Conn.	1.70	May 1, 1877..	Dec. 30, 1877	26,470
8	D. V. Howell, New York City,†..	1.77	May 1, 1877..	Nov. 30, 1877	25,424
9	Asa C. Palmer, Fayetteville, N. Y.†	1.88	May 1, 1877..	Nov. 30, 1877	23,937
10	John F. Hamilton, Portland, Me.†	2.00	May 1, 1877..	Nov. 30, 1877	22,500
11	Staples & Phillips, Taunton, Mass.	2.08	May 1, 1877..	Nov. 30, 1877	21,634
12	Clinton Stephens, New York City.	2.20	May 1, 1877..	Nov. 30, 1877	20,454
13	Swift & Linker, Providence, R. I.	2.20	May 1, 1877..	Nov. 30, 1877	20,454
14	Emil von Trentini, New York City	2.20	May 1, 1877..	Nov. 30, 1877	20,454
15	John L. Hopkins, Vinal Haven, Me‡	2.90	May 1, 1877..	Nov. 30, 1877	15,517
	Colby & Trumbull, Lawrence, Ms.§	2.32	May 1, 1877..	Nov. 30, 1877	19,396

* Guarantors' signatures not witnessed.

† Signature to proposal not witnessed.

‡ Guaranty not properly made out.

§ Received at 10.50 A. M.,—not considered.

The contract was awarded to Patrick Harrington & Co., of Groton, Conn., at $1.29 per ton. They commenced work in May, and up to this date have placed 9,041.35 tons in the main work and in the detached piece.

The work of putting in stone will be continued through the season. In addition to this work it is proposed to employ a vessel, with hoisting apparatus and divers, to remove bowlders from the anchorage sheltered by the breakwater.

The funds now available are thought to be sufficient to complete the smaller breakwater, designed for the business of the island.

The original survey, upon which estimates were made for this work, was made under the direction of Col. D. C. Houston, United States Engineers, in 1867.

A Board of Engineers was convened under date of February 18, 1868, to report plans and estimates for this work. Their report was published as Senate Mis. Doc., No. 81, Fortieth Congress, Second Session. Estimates were made by this Board for three breakwaters:

First. One for a harbor large enough for a shelter for the largest vessels, the estimated cost of which was about $3,000,000.

Second. A breakwater for a harbor for local purposes, to extend from the shore out 500 feet, to "Five-foot Rock," to cost $372,000.

Third. A breakwater for a harbor for local purposes to extend to a point 300 feet beyond "Five-foot Rock," to cost $553,798.

The breakwaters for local purposes, estimated for by this Board, were to be of riprap stone, with the outer or seaward slope faced with stone of from two to five tons weight, and to be surmounted by a parapet or wall of cut stone above low water.

The work of construction was commenced in October, 1870, by throwing in riprap stone. The season's work demonstrated that to carry on this work cheaply, shelter must be had for vessels engaged in the work. This was done by building a timber crib in the shore angle of the breakwater, inclosing an area of about 250 by 300 feet, with an entrance 60 feet wide. This enclosure was dredged to seven feet depth at mean low water. The rise of the tide being about 3.2 feet, vessels drawing ten feet can enter this basin at high water.

Instead of surmounting the breakwater with a parapet of cut stone, as proposed by the Board of Engineers, we have built it to the required height with riprap, or quarry stone, thereby effecting a considerable saving in the cost of the work.

The present condition of the work is as follows: The main breakwater is completed to a point 500 feet beyond the "Five-foot Rock," and 1,325 feet from the south side of the inner harbor, or basin. This it is proposed to extend about fifty feet farther.

The detached piece was commenced at a point 200 feet beyond, and on line with the outer end of the main work.

The detached piece makes an angle of fifteen degrees to the left, at a point about fifty feet from the south end, and an additional fifteen degrees at a point 100 feet from the south end. From this point it is to be continued in a straight line as far as this contract for stone will build it. The present length of the detached pier is about ninety feet. It will probably be about 250 feet in length on completion of this contract.

The following appropriations have been made for this work:

July 1, 1870	$30,000
March 3, 1871	75,000
June 10, 1872	50,000
March 3, 1873	50,000
June 23, 1874	20,000
March 3, 1875	20,000
August 14, 1876	40,000
Total	$285,000

In justice to the engineering of this work, it should be considered finished according to the original plan of procuring sufficient shelter for the use of the business of the island. More shelter has been secured, and at a cost much less than estimated. Like all such works, it will, in time, need repairs, and like all such improvements, too, there will probably be a need of extending it, for it has become the resort of numbers of fishing vessels, not connected with the island, and they sometimes quite fill the harbor.

The mackerel fishermen and menhaden fishermen would at times fill up a harbor of double the present capacity, and it will undoubtedly be sought by ordinary coasters, to properly accommodate which would require a harbor not less than four or five times the present capacity.

The increase of area for anchorage can probably be doubled or trebled by removing bowlders and dredging, and as far as the enlargement can be made in this way, it is probably cheaper than by extending the breakwater.

At the close of this season's work it is proposed to submit a final report, reviewing the subject in detail, and giving plans and estimates of cost of meeting the probable wants of the future.

Block Island is in the Newport collection district. Newport is the nearest port of entry. The amount of revenue collected during the fiscal year, ending June 30, 1876, was $258.20.

MONEY STATEMENT.

July 1, 1876.	Amount available		$22,447 70
Amount appropriated by act approved, August 14, 1876			40,000 00
July 1, 1877.	Amount expended during fiscal year	$13,136 07	
July 1, 1877.	Outstanding liabilities	2,332 67	—$15,468 74
July 1, 1877.	Amount available		$46,978 96

B—10.

Pawcatuck River, Rhode Island and Connecticut.

The projected improvement of this river, viz: a channel seventy-five feet wide and five and one-half feet deep, was completed and reported on in my last annual report, since which time nothing has been done. The small balance from the last appropriation I have reserved to meet any contingency that might arise, from the sinking of a vessel or other obstruction of the channel. A history of the improvement of this river is given in the Annual Report of the Chief of Engineers, 1876, part I, pp. 210–211.

The Pawcatuck river is the dividing line between Stonington and Providence collection districts. Stonington is the nearest port of entry. The amount of revenue collected during the fiscal year ending June 30, 1876, was $1,284 at Stonington, and $182,352.57 at Providence:

MONEY STATEMENT.

July 1, 1876.	Amount available	$176.37
July 1, 1877.	Amount expended during fiscal year	74 40
July 1, 1877.	Amount available	$101 97

B—11.

Little Narragansett Bay, Rhode Island and Connecticut.

Congress by act, approved March 3, 1875, authorized a survey of this bay to be made. This survey was made by me in accordance with instructions dated March 22, 1875, in the summer of 1875, and reported on under date of Nov. 30, 1875. (See Report of Chief of Engineers for 1876, part I, pp. 217–221.) The improvement recommended by me in this report, was a channel 200 feet wide and 7½ feet deep at mean low water, to be located along the north shore of the bay, to avoid the danger of being filled by shifting sands, and to give good sailing ranges. This channel was to be made by dredging. In addition to the dredging the removal of some rock was also recommended. Congress by act, approved August 14, 1876, made an appropriation of $5,000 for this improvement. The expenditure of this money was not authorized until April 30, 1877.

It is proposed expending this appropriation in prosecuting the plan of improvement recommended: $3,500 to be spent in dredging by contract, and $1,500 used for removing rock to be done by hired labor.

Advertisement for proposals was made, dated May 8, 1877, for dredging. The contract was awarded to W. H. Molthrop, of New London, Conn., the lowest bidder at the letting, June 8, 1877.

The following abstract shows the number of bids received, prices, &c:

Abstract of Proposals received at the Engineer Office United States Army, Newport, Rhode Island, June 8, 1877, *at* 10 *A. M., for dredging in Little Narragansett Bay, Rhode Island and Connecticut.*

Number.	NAME AND ADDRESS OF BIDDER.	Price per cubic yard dredging.	Price per cubic yard rock.	Average on basis 2 per cent. rock.	Commence	Complete	$3,500 will pay for—
1	William H. Molthrop, New London, Conn.	$0.30	$5.00	39.40	Soon as required....	Nov. 30, 1877	8,883¼
3	Morris F. Brainard, Albany, N. Y.....	0.23	11.00	44.54	July 1......	Nov. 30, 1877	7,858$\frac{1}{10}$
3	John H. Fenner, Albany, N. Y........	0.25	12.50	49.50	June 20.....	Nov. 30, 1877	7,070$\frac{7}{10}$

The estimate submitted by me for the entire improvement, $51,000 less $5,000 appropriated by act approved August 14, 1876, leaves $46,000, requisite to complete the work. One-half of this amount could be advantageously expended during the next fiscal year, as this amount, with that already appropriated, would open a channel probably 100 feet wide, that could be used by vessels navigating the Pawcatuck river, and would enable them to more fully realize the benefits of the improvement of that river completed by the general government last year.

Little Narragansett Bay is the dividing line between the Stonington and Providence districts. Stonington is the nearest port of entry. The amount of revenue collected during the fiscal year ending June 30, 1876, was $1,284 at Stonington, and $182,352.57 at Providence.

MONEY STATEMENT.

Amount appropriated by act approved August 14, 1876..	$ 5,000 00
July 1, 1877, amount available........................	5,000 00
Amount (estimated) required for completion of existing project....................................	46,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1879..............................	23,000 00

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THIRD ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1879.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1879.

State of Rhode Island and Providence Plantations.

THIRD ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1879.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1879.

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The Commissioners.

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Third Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, reappointed Nathaniel F. Potter, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

OFFICE.

As a measure of economy, the office of this Board was moved, in July, to rooms in the building at the corner of Market Square and Canal street, in Providence, where accommodations are obtained at a rent of two hundred dollars per year.

U. S. GOVERNMENT APPROPRIATION.

The Harbor Commissioners are authorized and empowered by Section 4, of Chapter 611 of the Public Laws, passed at the January Session, 1877, to apply to Congress for appropriations for protecting and improving any harbor in the State. Acting for the State under this authority, they petitioned Congress for an appropriation for dredging the channels leading to Providence harbor. A copy of the petition, and a statement in regard to the need for a Government appropriation, made to Gen. G. K. Warren, U. S. Engineer, in charge of this district, were contained in the Appendix to our report of last year. In March, two of our members proceeded to Washington to attend a hearing before the House Committee on Commerce, to whom our petition had been referred. The Commissioners were accompanied to Washington by the President of the Board of Trade, and by representatives of the city government of Providence, and of business interests in Providence. Full plans and profiles of the river and harbor, with documents in regard to the trade and need of improvement, were presented to the Committee, and explanations of the matter were made by members of the delegation and by Representatives to the U. S. Senate and House of Representatives from this State.

The application resulted in an appropriation of $50,000 for the improvement of the river and bay, to be expended under the direction of the U. S. Engineer in charge of this district. It is estimated that the whole improvement projected by the Harbor Commissioners, and towards the cost of which this is the first appropriation, will require about $500,000. This expenditure will secure a channel twenty-three feet deep at mean low water, and of suitable width for convenient use, from the wharves in Providence to the sea, both by the western passage and by the middle passage. More detailed information in regard to this channel may be found in the Appendix to this report.

Gen. Warren, U. S. Engineer in charge, asked the opinion of this Board in regard to the most desirable channel to be gained by the expenditure of this first appropriation, and requested us to designate a dumping ground for the dredged material. The reply of the Commissioners is printed herewith as Appendix A. This was presented to Gen. Warren by two members of the Board, accompanied by Senator Anthony, Mayor Doyle and Mr. Aldrich, President of the Board of Trade, when a conference was held upon the subject. Gen. Warren approved the views of the Board, and his specification of the work contained the following provision: "To excavate in Providence river, R. I., between Fox Point wharf and Field's Point, a channel of a depth of twenty (20) feet at mean low water, and of as great a width

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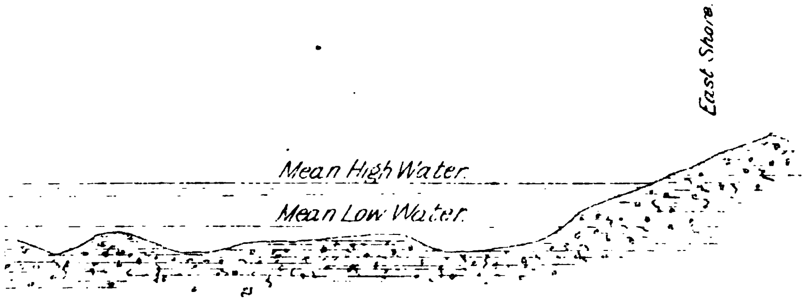

East Shore
Mean High Water
Mean Low Water

as the available money will pay for, where there is at present a depth of from thirteen (13) to twenty (20) feet at mean low water."

The contract was awarded to E. R. Seward, of Albany, at 11½ cents per cubic yard, and the material is to be deposited in the deepest parts of Narragansett Bay, east of Conanicut Island, requiring an average distance of towage of nineteen miles, or at such points on the margins of Providence harbor or river as the riparian owners might agree to, and the local authorities permit. The price at which the cost of the whole scheme was estimated was at the rate of seven yards for a dollar.

Upon the accompanying sketch of Providence harbor, the approximate boundaries of the proposed channel, 1,060 feet in width, are represented by heavy dotted lines, and upon the section across the bar in Providence harbor is represented by hatched surface a cross-section of the proposed channel, and the amount of dredging needed to obtain it at the shallowest part of the harbor.

A further appropriation of $60,000 has recently been made by the U. S. Government for the continuation of the above work.

The work, under Gen. Warren's direction, was continued during the season, until it was stopped by cold weather.

DUMPING GROUND.

In addition to the deposit of dredged material on the permanent dumping ground designated by the Board, opposite Sand Point, east of Prudence Island, a limited amount of dumping has been allowed, under restrictions, near the shores of Providence harbor, above Devil's Hand rock, on the east side, and above Sassafras Point, on the west side. Temporary permission was also given for dumping on the easterly side of Seekonk river, near Twin Islands, and above Walker's Point.

HARBOR LINES.

In their second annual report, the Commissioners stated their intention of submitting for approval a plan of harbor lines in Pawtucket, from the falls to Bensley's Point on the one side, and to Bass rock on the other; also a plan of harbor lines on the west side of Seekonk river, from Bower street to Central or Red bridge.

These plans, accompanied by a communication in regard to them, signed by the Commissioners, March 5, 1878, were forwarded to the Governor and Senate, and on the 8th of April, the several lines were approved.

The plan of harbor lines on both sides of Seekonk river, near India Point, and on the east side of the harbor, from Bold Point to Kettle Point, referred to in the above named report, are before the General Assembly for action. Full descriptions of the lines accompany the plan.

A new harbor line on the west side of Providence river, between Crawford street bridge and Point street bridge, was established by the General Assembly, upon recommendation of the Harbor Commissioners, on the 27th of April. There are considerable encroachments beyond the old harbor line below Point street bridge, which have received the attention of the commission. The encroachments were made before the establishment of this Board, and may have been innocently caused or suffered by the riparian owners. In some cases, it appears that the wharf walls are still moving out into the harbor, for the want of a stable foundation; and it is our opinion, that some wharves which now encroach were built back of the harbor line.

A plan for a new harbor line on the east side of Providence river, from Crawford street bridge to Fox Point, is now before the General Assembly for action. A full description of the line accompanies the plan, and its location is referred to the stations of the U. S. Coast Survey, by means of which the position of the line may be found, even if the local landmarks have disappeared. Such reference is now made of all lines established by the Board. The proposed line covers all present encroachments, except on a part of the wharf of the Fall River Iron Works Company.

The Board has under consideration the establishment of a harbor line from Sassafras Point to Field's Point. A long, low sand spit juts into the channel at Field's Point, which is owned by the city of Providence, and has been formally devoted by the City Council to the improvement of the water way, which has, at this place, an available width for navigation of less than seven hundred feet.

A petition, signed by many riparian owners, was presented to the Board in May, praying for the establishment of harbor lines from Field's Point to Pawtuxet beacon, and offering to incur the necessary cost of surveys and plans for this purpose. The Commissioners gave several hearings, and indicated in a general way lines which they would approve. These lines met the approval of the petitioners, so far as they were represented at the hearings, but no provision for the cost of surveys and plans has yet been made by them.

BURGESS OR BOLD POINT AND MARINE RAILWAY.

At the hearing held September 25, in regard to the establishment of harbor lines on the east side of Seekonk river and Providence harbor, the importance of cutting off a part of the artificial construction at Burgess Point, and restoring nearly the natural shore line in that vicinity, was urged by the Mayor of Providence. An adjournment of the hearing was made for the purpose of allowing consultation between the representatives of Pawtucket, Providence, East Providence and the railroad interests which would be affected by a change. No progress sufficient to be reported has, at this time, been made; and although the Harbor Commissioners recognize the injury which results from the building out into the river at this point, they deemed it best to report the harbor line as first designed, rather than to allow the evident evil of the old line to continue. We do not see that action on the new line as proposed, will hinder in any way the establishment of the more desirable line restoring, in a measure, the original shore boundary, if that should prove to be practicable.

FIELD'S POINT.

Reference has already been made, under the head of harbor lines, to the spit of sand projecting toward the channel at Field's Point. The proceedings of the City Council in reference to this matter will be found recorded in Appendix C.

BROOK STREET DISTRICT IMPROVEMENT.

In April, 1877, information was received from the Joint Special Committee on the Brook street district, of the city of Providence, that they were in negotiation with certain parties to construct wharves along the west side of Seekonk river, above Washington bridge. Steps were therefore taken by the Harbor Commissioners towards the establishment of a harbor line in that locality. Mention was made in our last annual report of various hearings with engineers, representing the city, and with the Brook street district Committee, in regard to the proposed constructions. The harbor line having been established, it was proposed by the city to excavate a trench in the mud, on a line parallel with the harbor line, and a suitable distance back from it, to a considerable depth, and then to fill with material taken from the Brook street district, and to protect the slope towards the channel by riprapping it with large stones. This scheme the Committee asked the Board to approve. The mud is very deep and soft at this point, and it is believed that the hard ground on which the mud rests slopes rapidly towards the channel. It was the opinion of the Commissioners that such filling would be objectionable, between Bower street and India bridge, without some bulkhead or proper retaining wall. The Committee, however, expressed their confidence that the displacement of mud by the filling would be comparatively slight, and that such displacement as would occur would be mostly by the vertical settlement of the filling. The importance to the city of this ground as a place of deposit for surplus material from the Brook street district was urged, and the Commissioners finally assented to a provisional license for the work, under which the city should become responsible for all material displaced beyond lines approved by the Commissioners, and enter into a contract to dredge an equal amount from the river and harbor at such places as the Commissioners should direct, and to their satisfaction. This contract would quite protect the public interests, and at the same time relieve the Board from the responsibility of preventing work which the representatives of the city considered desirable. The provisional license was issued on the second day of March, 1878, and the contract, in accordance therewith, bore the same date, though it was not executed until some months later. The contract bore the approval of the Attorney General. Copies of both documents may be found annexed to Appendix D. The work proceeded, and the result more than justified the opinion of the Harbor Commissioners that a great lateral displacement would occur. The amount of filling put into the work is stated by the City Engineer at 36,800 yards. The amount remaining in the work, above the original surface and back of the lines approved by the Harbor Commissioners, is stated at 3,900 yards. It thus appears that about nine-tenths of all the filling placed here by the city has gone out into the river beyond the approved lines, or displaced an equal amount of other material. The position approved by the Harbor Commissioners for the embankment, was sixty-five feet back of the harbor line for the top of the slope at a level six feet above mean high water. The outer slope, which was to be protected by a rip-rap wall of large stones, was to be at the rate of one and one-half horizontal to one vertical. In July last, the effect of the filling appeared to have raised the bottom of the channel opposite the middle of the work for a distance of more than two hundred feet outside of the harbor line, and about sixty feet from the harbor line the channel had been filled about seventeen feet above its former level. Nearly opposite the lower portion of the work, the filling of the channel was about eighteen feet or more in depth at a distance fifty feet outside of the harbor line. It is probable that the swift current near this filling constantly washed away the surface of the mud as it was pressed out into the channel, and that the real movement of the bottom was greater than the above figures indicate.

The proposed work is far from complete. The larger portion of the area inside the embankment is at about, or in places several feet below, the level of high water, while it was intended to be six feet above it. The outer slope is from ten to forty feet or more beyond its approved position, and even in its present condition the work is not yet quite in equilibrium, but still settles and has a slight movement laterally. The filling back of the embankment, as proposed, will add a new load, and the dredging away of the earth at the foot of the embankment will remove a present support.

The contract provides for the completion of this work to the satisfaction of the Harbor Commissioners, and also for the removal of an amount of material equal to that displaced from the river or harbor, at such places and in such manner as the Harbor Commissioners may direct, before the liability of the city is discharged.

Similar filling, under similar conditions, but with much less extent of displacement, has been done by the city a little farther up the river than that above described. Dredging has been done here by the city, to remedy the injury caused by the filling, and the Harbor Commissioners have expressed their satisfaction with it.

ENCROACHMENT.

The harbor line established on the west side of Providence river by act of the General Assembly, passed April 27, 1878, left a portion of the Dorrance street wharf as an encroachment into the river. On the 8th of May, a representative of the wharf property appeared before the Board, and stated his wish to repair this portion of the wharf and put it into a condition so that use could be made of it. He was informed that authority could not be granted for him to proceed with any construction beyond the harbor line, and if he persisted in going on with the work, the attention of the Attorney General would be called to the matter. A petition is now before your honorable body to make a change in the harbor line, to give relief in this case. Some repairs were made, but no action has been taken in regard to the matter by the Commissioners, pending your action upon the petition.

LICENSES.

The following licenses to build wharves have been issued:

1. March 2, (provisional) to the city of Providence, to build an earth embankment, protected by a riprap wall, on the west side of Seekonk river, northerly from Front street, a distance of about 400 feet.

2. April 10, to the Compressed Asphalt Block Company, for pile wharf, 104x108 feet, near India street, west of Ives street, in Providence.

3. May 1, to Alexander Duncan, to rebuild and repair "Butler's wharf," near Dyer street, in Providence.

4. September 25, to Maguire Brothers, for 60x50 feet pile wharf and wall, in East Providence, on the Seekonk river, above Washington bridge.

5. October 9, to Darius Goff, for about 180 feet of wharf retaining wall, along the harbor line on the east side of the river, in Pawtucket.

6. November 20, to the Lonsdale Company, to rebuild a portion of their wharf, 150x50 feet, near India street, in Providence.

TIDES IN SEEKONK RIVER.

There is evidently great obstruction to the flow of the Seekonk river near its mouth, by artificial constructions at India Point. The current is made so swift and irregular by the bridge piers and foundations that navigation during the ebb and flow is very difficult and dangerous and is rarely attempted. The volume of tide water passing into the large receiving basin above these bridges is much lessened by the obstructions, and thus the advantage of its scour in the channels is lost. The United States Advisory Council considered the propagation of the tides at this point worthy of study and they recommended comparative guagings. Tide guages were accordingly established about the first of September, at points indicated on the accompanying plan of Providence Harbor, by Numbers 1, 2 and 3. No. 1 is on the Boston and Providence R. R. Co.'s wharf, below the bridges. No. 2 is between them, and No. 3 is at Carpenter's wharf above the bridges. Observations were begun on Sept. 4, and continued until October 7, exceeding therefore a complete lunation. During week days readings were taken at each of these stations every twenty minutes, by a special observer, from 5 A. M. to 7 P. M., and at night and on Sundays, officers of the Providence police, through the kindness of the Mayor, took times and measurements of high and low water.

The readings obtained were measurements from a fixed point to the surface of the water as it stood in a protecting box, and were made by using a graduated rod, having a hollow copper sphere attached to float its zero at the water line. The fixed point was at the same level at the three boxes, and was eleven feet above the zero of the bench-mark on the western abutment of the Railroad Bridge, established by the Coast Survey in 1874.

Measuring along the channel, Station 2 is 400 yards from Station 1, and Station 3, 300 yards from Station 2.

The observations have been platted and studied, and yield the following results, which should be prefaced by the statement that the range of tide was obtained by a simple average of the heights of high and low waters during a period of 29½ days, or one lunation; the figures for springs by combining the reading for those tides which occurred on days when the moon's transit fell between 0½ and 1½ A. M. and P. M.; and the figures for neaps by combining the readings for those tides which occurred on days when the moon's transit fell between 6½ and 7½ A. M. and P. M.

At Station 1. The average reading for high water was 6.28, for low water 10.84, giving for the mean range 4.56 feet. The spring tides during the lunation rose above the mean high water level of the observations 0.63 foot, and fell below the mean low water level 0.65 foot, giving a range for springs of 5.84 feet. The neap tides did not rise to the mean high water level by 0.32 foot, nor fall to the mean low water level by 0.81 foot, giving a range for neaps of 3.43 feet. High water occurred at No. 1 on an average at 8 hours, 7 minutes, after the moon's meridian passage.

At Station 2. The average reading for high water was 6.28, for low water 10.78, giving a mean range of 4.50 feet. The spring tides during the lunation, rose above the mean high water level of the observations 0.61 foot, and fell below the mean low water level 0.61 foot, giving a range for springs of 5.72 feet. The neap tides did not rise to mean high water level by 0.32 foot, nor fall to mean low water level by 0.80 foot, giving a range for neaps of 3.38 feet. The tide at No. 2 was generally observed to commence rising a little later than at No. 1, and less rapidly, so that at three-quarters tide—observed to be usually the time of greatest difference on the flood—it lagged five minutes behind the No. 1 tide at neaps, and ten minutes at springs. High water was not attained at No. 2 till after it had been attained at No. 1 by times varying from five to twenty-five minutes.

At Station 3. The average reading for high water was 6.30, for low water 10.74, giving a mean range of 4.44 feet. The spring tides during the lunation, rose above the mean high water level by 0.62 foot, and fell below the mean low water level by 0.52 foot, giving a range for springs of 5.58 feet. The neap tides did not rise to the mean high water level by 0.34 foot, nor fall to the mean low water level by 0.76 foot, giving a range for neaps of 3.34 feet. The rising of the water at No. 3, in relation to the rising at No. 1, was observed to vary from rare coincidence therewith to thirty minutes thereafter. At three-quarters flood, the tide at No. 3 was from ten to twenty-five minutes behind the tide at No. 1, lagging most at springs and least at neaps. High water at No. 3 was not attained, till after it had been reached at No. 1, by times varying from ten to thirty minutes.

Assuming that the observation at No. 1 indicate the normal tidal condition for this region we may, by comparing the observations at Nos. 2 and 3 therewith, discover in what directions and to what extent this condition has been altered at these points.

First—As to the rate of propagation: The stations being in such proximity, propagation between them should be almost instantaneous. It does not appear from the observations that propagation between 1 and 2 is to any great extent interfered with. But between 2 and 3 the propagation is so far obstructed that at times it requires thirty minutes for the effect of the rising tide apparent at No. 1 to be felt at No. 3. An idea of the extent of the retardation at ordinary spring tides may be had by referring to the appended diagram, which is a plotting of observations on an actual tide. By following up the vertical line corresponding to any hour, one may read off, at its intersection with the curves, the heights at the several stations at that time. Or by followlowing the horizontal line corresponding to any foot, one may read at its intersection with the curves, the times which elapsed between the attainment of this height at the various stations. This diagram shows the tide at No. 2 lagging generally 6 minutes behind that at No. 1; the tide at No. 3 lagging 25 minutes behind that at No. 1.

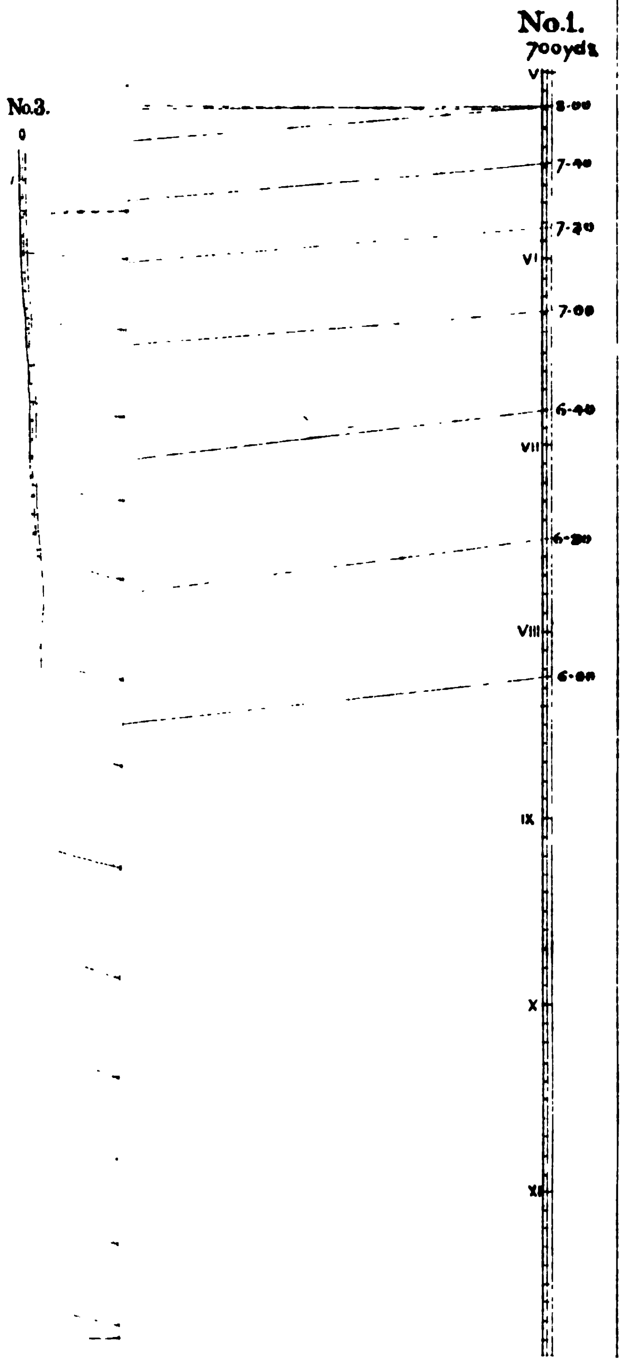
Second—As to the low-water plane: The mean low-water reading at No. 1 was 10.84, at No. 2 10.78, at No. 3 10.74, giving a rise in the mean plane, from 1 to 2 of ¾ of an inch, and from 2 to 3 of ½ an inch, or a total rise from 1 to 3 of 1¼ inches. At neaps the rise in the low-water plane from 1 to 2 is ⅝ of an inch; from 2 to 3 the plane is level. At springs the rise in the plane from 1 to 2 is 1¼ inches, from 2 to 3, 1⅝ inches, giving a total rise from 1 to 3 of 2⅞ inches.

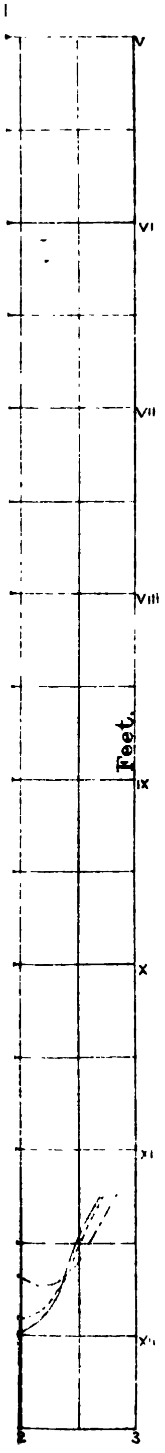
Third—As to the range of the tide: The mean range is ¾ of an inch less at No. 2 than at No. 1, and ¾ of an inch less at No. 3 than at No. 2, giving a total loss at No. 3 of 1½ inches. For neap tides the range is ⅝ of an inch less at No. 2 than at No. 1, and ½ an inch less at No. 3 than at No. 2, or a total loss at No. 3 of 1⅛ inches. For springs the range is 1½ inches less at No. 2 than at No. 1, and 1¾ inches less at No. 3 than at No. 2, giving a total loss of 3¼ inches in the range of spring tides for the reach of Seekonk river above Washington bridge. In other words, at spring tides, 19½ million cubic feet of water, which, in the normal condition of the tides would daily enter and withdraw from the Seekonk, is in some way prevented from so doing.

The two most important effects on the Providence navigation of these changes in the orderly flow of the tides are, the creation of violent currents and the loss of scour.

The first of these effects is apparent to any observer standing on the bridges. A clear idea of its cause may be had by examining the appended diagrams of the flow and ebb of an ordinary spring tide. These diagrams show approximately the forms assumed by the surface of the water during different stages of the tide, and are made up from the readings of the tide, the curves of which are also shown. The forms are but approximate, since in all probability the incline which appears in them belongs altogether to a short space extending on either side of the bridges,—the lines from 1 and 3 being horizontal to quite near the bridges. On these diagrams a graduated scale is shown at each station, the feet being marked with Roman numerals; at the right the times appear in Arabic. They show, for example, that at 6.40, on the flood tide the reading at No. 1 was 6.8, while owing to retardation, the reading at No. 2 was 7.13, and at No. 3, 7.65, giving during the latter half of the flood a fall on the surface of the water between d.

27.





V
VI
VII
VIII
Feet.
IX
X
XI
XII
2
3

1 and 3 of more than 8 inches. To this incline on the surface of the water, occasioned by retardation, are due the currents during both flood and ebb, which at times attain the velocity of five miles an hour. When it is remembered that in a clear way a current of six knots an hour is navigable only with great difficulty, one appreciates that to pursue a sinuous course which runs athwart the line of a five-mile current, at varying angles, and which is thickly studded with obstacles, is attended with great peril.

In considering the loss of scour which the alteration of the original tidal condition of the Seekonk river occasions it should be borne in mind that the regime of a channel is a function, not of the mean tidal flow, but of the flow of the highest spring tides at the time of maximum scouring effect. The figures given in this matter of scour, therefore, which are obtained from the tide, the observations of which are platted on the appended diagrams, and which was an ordinary spring tide, rather under-state than exaggerate the extent of this loss.

By reference to the accompanying diagram representing the spring tide of September 27, it will be noticed that the tide at Station No. 1 had sensibly slackened in its rate of fall at 1:20 P. M. After that time it may be assumed that the volume of water remaining in the Seekonk basin would have very little value in scouring effect upon the channels below. The high tide level at Stations 1 and 3 was about the same and the whole fall of the tide at Station 1 was 6.84 feet, but at 1:20, when the scouring value had ceased, the height of the water at Station 3 was 0.70 foot above that of Station 1, and it may be said, therefore, that one-tenth of the volume which might have escaped from the Seekonk had failed to do so at a time to be of value in scouring the channels below.

During the hour of greatest scouring effect—soon after half-tide—the flood at No. 3 flows 63,720,000 cubic feet. Taking the tide at No. 1 to indicate the normal condition, it should flow 70,920,000 cubic feet. This shows a loss in the scouring effect of the flood tide of ten per cent. In this tide the rate of flood flow is more rapid than that of the ebb. As a rule in our harbor the ebb flow is most rapid.

During the hour of greatest scouring effect of the ebb tide the discharge at No. 3 was 58,520,000 cubic feet. The tide at No. 1 indicates that it should have been 67,320,000 cubic feet, showing a loss in scouring effect of 16 per cent. The city of Providence has expended upward of $99,600 in dredging the harbor since 1870. What percentage of this amount might have been saved had not the scour of the current been thus greatly impaired, it would be interesting but fruitless to inquire; but in considering—now that a new condition of channel is in process of establishment by dredging in the main harbor—how far the restoration of the lost sixteen per cent. might avail to maintain it, there may be much profit. We do not pursue this question at the present time for the reason that much of the information we have obtained bearing upon this and other questions in regard to the effect of the obstructions has not been so fully studied as is desirable before stating our conclusions. Many useful observations in regard to the action of the tide in the river between Washington bridge and Pawtucket have been made by Mr. H. A. Bentley, assistant to Gen. G. K. Warren, U. S. Engineers, which we expect to avail of.

BRIDGES IN SEEKONK RIVER.

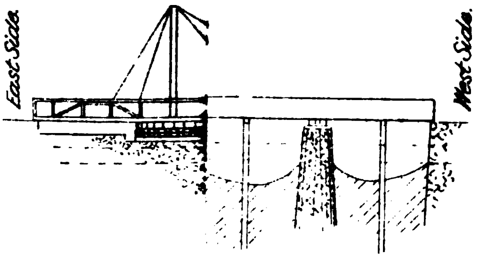
An examination of the sketch appended to this report and entitled, "Obstructions at the Mouth of Seekonk River," reveals the substantial cause of the change in the "natural and orderly flow of the tides" which the observations discussed above indicate. This sketch shows in plan the two bridges at India Point, and in profile exhibits the forms of the foundations on which they are reared. Complaint as to the location of the draws of these bridges is frequent; so they appear objectionable in respect to both foundation and superstructure, and in these two respects are to be considered.

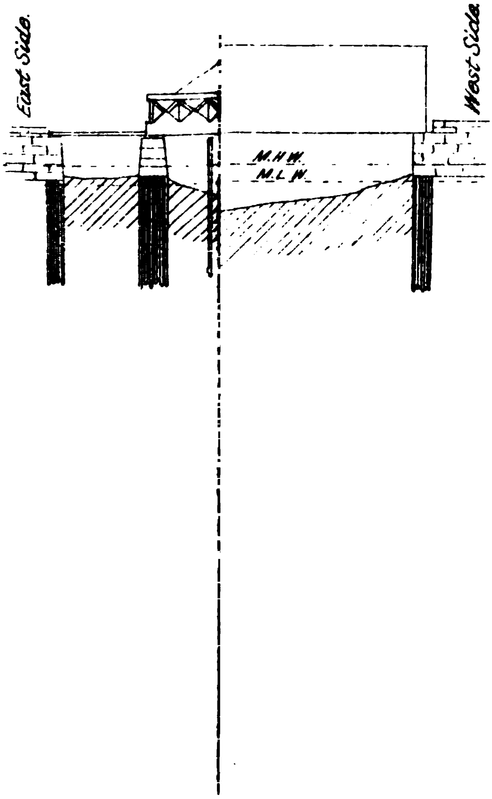
First, as to foundations: The considerable formation on which the Washington bridge is imposed is the product of the intermittent labor of eighty years past. The first Washington bridge was built in 1793. It had six piers, entirely of piles, and a draw on the east bank where the present draw is. In 1807 a storm carried it away. The piers were repaired, and a new superstructure supplied. This was carried away in

1815. In repairing this damage the three piers just west of the draw were surrounded with rubble stone work. To form a foundation "large quantities of stone were dumped in around the piles until they were heaped up to the water line. It is said they worked some time in getting in these stones, and that after everything was fixed to their satisfaction the masons went out one morning to build the piers, and found that their foundation had disappeared. It had sunk down through the soft mud forming the river bed. More stones were thrown in and the piers built up." "During the spring and summer of 1867 a portion of the stone forming one of the piers fell down." When the present bridge was built the three piers unimproved in 1815 were treated with stone, as the others had been. A result of this work since 1793, is that to-day, while the sectional area just above Washington bridge is 13,620 square feet at high water, and 11,020 square feet at low water, the corresponding water areas on the bridge axis or along the ridge of its foundation, are 3,810 square feet, and 2,370 square feet; 2,370 is 21½ per cent. of 11,020. Originally the bottom on the axis was of very soft mud, which a stream running at a velocity of one-half mile per hour would, it is believed, serve to work up and move, so that it is to be presumed that before 1793 the stream had made for itself a channel at this point perhaps equal in area to that which at present exists above. On this basis 78½ per cent. of the original area has therefore been lost. The stone persistently added, aided by the material of crumbling piers, has formed an obstruction across the channel, rising, as our sketch shows, twenty feet above the level of the bottom to the north, and having on its southerly side a slope of two to one—a slope frequently given by engineers to dams. In fact the whole effect of these obstructions across the bed of the stream has strikingly the appearance of dams on a mill stream. To remove so much of the obstruction at Washington bridge as to give a depth of fifteen feet at low water would require the excavation of 7,080 cubic yards of material—presumably stones of various sizes. Each decaying pier, as it fell away into the channel, by diminishing the area of flow, increased the force of the current, which its fellows had to resist, and each stone added to the foundation had to oppose a velocity enhanced by itself, till, at the present time, the embankment has caused, and shows itself capable of withstanding a current at spring tides of five miles per hour.

The present railroad bridge was built in 1867–8. Previous to the construction of the present bridge, a bridge built in 1835, and succeeding repairs on it, contributed to the formation of an obstruction at this point. The bridge of 1835 had three pile piers as at first built. In 1857 three more were added at the center of the spans. The draw of 1835 was supported on piles and a platform, "the piles and capping of which still remain." In 1858 the old draw was removed and a new one substituted. "The abutments which were continued as a bank wall above the bridge on the west end, and above and below on the east end, were built of rough stone. No piles were driven, but a thick layer of good brush was carefully strewn on top of the mud, and the foundation stone laid directly on this."

Some of the old piles were removed in 1866, in preparing for the present bridge. This bridge has four piers between the abutments, one of stone, three of piles surrounded with iron cylinders under Cushing's patents. "After the completion of the piers rubble stone was thrown in around and between the cylinders, on top of which was placed about a foot of slag from the puddling furnaces of the iron works. Cotton bags were then filled with oyster shells and thrown in, and on top of these another foot of slag." The bottom of the river at this point is covered with a crust of oyster shells four feet thick, through which the cylinders of the Cushing piers extend six inches into the soft mud. This fact limits the dredging, which may be safely done on the axis of the present bridge, unless we are prepared to allow the full section of channel which the current would scour in soft mud. The fact that soundings taken previously to the present construction on the axis of the bridge agree quite nearly with those made since, indicates that the work of 1867–8 added but little to the obstruction created in 1835. The area on the axis of the railroad bridge at low water is thirty-eight per cent. of the area with which the corresponding area of Washington bridge was compared.


East Side
West Side


East Side.
West Side
M.H.W.
M.L.W.

In building the railroad bridge it was found necessary to take into consideration a velocity of six miles per hour.

Second, as to the superstructure. The superstructure is objectionable on account of the location of the draws. Our appended plans show this location to be close to the eastern shore and out of the main channel. This condition of things above the water line, like that which exists below the water line and which we have just discussed, is an inheritance from the unfortunate management of 1793. The draw of the earliest bridge had this location; its successors copied it and seemed to entail some correspondence of position in the railroad bridge below. As the obstructions to the tidal flow impound the water, so the arrangement of the draws of the bridges tends to lock in the shipping, permitting its exit only at the stand of the tide, except at the risk of much damage. In regard to this we may quote from the report of Mr. Bentley to Gen. Warren, in 1874, to whom we also owe a part of the information for our appended sections on the axes of the bridges:

> "To facilitate the passage of vessels through this and Washington bridge, double lines of piling have been put in between the draws of the two bridges. This piling has been extended about 300 feet above Washington bridge, and one line has been extended about the same distance below the railroad bridge. The space between these lines of piles varies from 38 to 60 feet. Vessels going up the river enter this passage at an angle with the current, and pass the railroad bridge at an angle of 20° with the axes of the piers. When they reach Washington bridge a turn must be made to the left of about 45°. This turn has to be in the draw of the bridge, where the passage is only 38 feet wide. These vessels pass up the river at high water, when there is but little current. They cannot tow through safely, because of the sharp turn above alluded to, but have to warp through and make up the tow above. In descending they generally leave Pawtucket after the tide commences to run out, and reach these bridges when the current is very swift, often as much as five miles per hour. To break up a tow in a current like this so as to enable the vessels to warp through would be attended with great danger of being carried down on to the bridge to the west of the draw. The only course is to be taken through by the tug, and this must be done at a speed greater than the current; in order to keep steerage way. In making this passage they are very frequently damaged by coming in contact with the piling. Once in the passage there is no escape, except with the current at the lower end."

In a report which introduces that of Mr. Bentley to the attention of the Chief of Engineers, Gen. Warren, after considering the propriety of devoting the amount of the Pawtucket river appropriation on hand to the dredging and redredging of shoals continually reforming, makes the following very pertinent statement:

> "But if something can be done at the bridges, I think it more important that it should be done there than altogether confined to the shoals above them. Before recommending that the last appropriation should be expended for this purpose, I would like to know what can be exacted from the bridge company. I beg here to refer directly to Mr. Bentley's report, page 14, on "the bridges." Their history and condition, the authority for building them, and what should be done is stated fully. At the Red bridge an expenditure of about $675 is required to remove stone from the east opening of the pivot-draw. It is now so obstructed that it is useless to navigation; and if the other draw-opening should be closed by a sunken vessel, all navigation of the river would be suspended. If the bridge company cannot legally be compelled to open properly this east draw-space, I would recommend that the present appropriation be used for that purpose. Under the heading "obstructions to tidal flow," etc., Mr. Bentley makes further estimates for dredging between the piers of the Red and Washington bridges, at an estimated cost of $8,085. This latter expenditure the means in our hands would not justify us in making, as it would prevent necessary dredging on the shoals above. I wish it would be ascertained, by proper reference, whether there is not legal remedy to compel this bridge company to restore the water-way to a proper natural width.
>
> The Washington bridge is in so bad a condition that it is expected to soon rebuild it; but it is a very serious obstruction to navigation, and it is not at all likely that, when rebuilt, it will be suited to the wants of navigation, unless some control is exercised over it by the general government. The present railroad bridge might have been. and should have been, better located.
>
> I deem it, therefore, a matter of importance that some steps should be taken—what ones, exactly, I do not know—to control the bridging of the Pawtucket river in the interest of navigation; and unless such control is acquired by the general government, it seems to me out of place to further regard the improvement of the Pawtucket river as a public one, or that that estuary is longer a navigable water of the United States.
>
> A small sketch in Mr. Bentley's report shows the location of the bridges.
>
> I will await an answer to this communication before taking any further measures toward dredging in the Pawtucket River."

Red bridge was built in 1793, on six piers. It was carried away in 1807. In rebuilding the pile piers were surrounded with rubble. In 1871 the bridge was rebuilt. "The piers are built of laid masonry, resting on the foundation of the old piers, except the pivot pier, which rests on a pile foundation" (Bentley). To protect the piers of the old bridge a large amount of stone was thrown in from time to time.

The sectional area of the channel, just above Red bridge, at high water, is 10,180 square feet, at low water 8,020 square feet. The area

on the axis of the bridge at high water is 3,972 square feet, at low water 2,514 square feet; 2,514 is 31 per cent. of 8,020. The obstruction rises twenty feet above the level of the bottom up stream.

Our quotations and the general facts in regard to the history of the bridges, where not otherwise accredited, are from a report of Col. J. Albert Monroe.

Three separate influences, therefore, urge a radical change in regard to the bridges which span the Pawtucket navigation at the mouth of the river. First, The injurious effect of the present structures, considered as obstructions, on the tidal flow, and the resulting evils, which we have endeavored to make manifest in our discussion of the tides. Second, The highly objectionable location of the draws, and Third, The fact that in the event of no change in the matter, the river is likely to be dropped from the consideration of the general government. The $52,000 appropriated by the United States during the past twelve years to its improvement and conservancy, do not measure the whole loss which the abandonment would entail; since the care of the government means the attention of the United States engineers and all that that implies.

Our examinations in regard to the tides and the bridges at the Seekonk river, have made it clear to us that the interests of navigation require a radical change in the present conditions, which change would involve the removal of the dilapidated Washington bridge with its piers and foundations, and the dredging of deeper water-ways between the piers of the railroad bridge and of Red bridge. It would be hopeless to attempt much improvement at Washington bridge without the removal of that structure, which is as nearly worthless as a bridge used for public travel can well be. There would be great advantage in building, in a new location, a double-deck bridge, suited to the railroad traffic and the highway travel, on the same foundations; but, if this should prove impracticable, it is our present impression that the channel under the railroad bridge can be so improved as to give substantial relief from the present disadvantages without disturbing the structure as it stands. We have a similar opinion in regard to the water-ways at Red bridge, and we understand that the engineer in charge of the recent reconstruction agrees with this.

The number of vessels passing through the draw of Red bridge, on the way to and from Pawtucket, is about sixteen hundred or more per year. When business was more active the number was greater. We have made no detailed estimates of the cost of the above mentioned improvements, but we are satisfied that the expense would be far less than the resulting value.

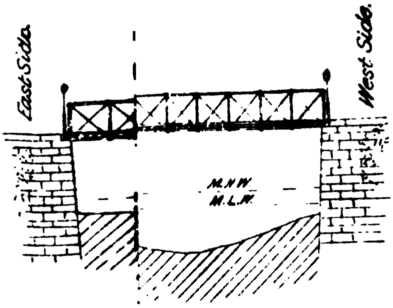
SURVEYS.

During the past year such surveys as were necessary to enable the commissioners to decide on the extent of encroachments into the harbor, and to design and locate the harbor lines proposed by them, have been made. As stated above these lines have been referred to the United States coast survey stations. To make the significance and value of this more evident, it may be well to explain that in carrying the triangulation system along the shores of the bay, the coast survey have established stations in a manner as nearly permanent as may be, the locations of which stations, in their system, forms part of the archives at Washington. It seemed to the board, therefore, that reference to these stations, provided more thoroughly for the contingency of lost land-marks than any other plan as inexpensive in its methods.

Beside this surveying of lines, quite extensive leveling operations have been carried on, with the object of establishing a common plane of reference, which it is hoped each of the three parties interested in the harbor, viz: the United States engineer department, the coast survey and the city of Providence, may agree to adopt for a plane of reference for future work. Hitherto each party has been working with a special base, and it is desirable, for the proper comparison of tidal observations or soundings, for example, made by each, that agreement in respect to a plane of reference should be brought about.

PAWCATUCK RIVER NEAR WESTERLY.

The attention of the board has been called to the need of some action on the part of the State, in regard to the construction of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wharves in the Pawcatuck river near Westerly, and a definition of their limits, if a fair degree of convenience in the navigation of the channel is to be preserved. This locality is not within the limits of the jurisdiction of this board, but the importance of the matter to the locality named seems to demand this refence to it on our part.

WORK OF THE UNITED STATES ENGINEER.

By the courtesy of Gen. G. K. Warren, the board has received a printed copy of his report upon the government works under his charge in Rhode Island, for the year ending June 30, 1878. The following is a brief summary from the report of the Chief of Engineers in regard to the work upon which Gen. Warren's report in full will be found in the appendix :

Pawtucket or Seekonk River, Rhode Island.

No work has been done during the fiscal year, and none will be done this season, unless the shoals become troublesome or the channel is accidentally obstructed.

Providence River and Narragansett Bay, Rhode Island.

The project for this improvement consists in making a wide channel, with a central depth of 23 feet at mean low water, from Providence to the sea, at an estimated cost of about $500,000.

The present ruling depth is about fourteen feet, the mean rise of the tide being about 4.7 feet.

It is proposed to expend the appropriation of $50,000 made by the act of June 18, 1878, in dredging a channel 23 feet deep at mean low-water, to such width as the means at hand will allow—not exceeding, however, 200 feet.

The appropriation of $5,000 contained in the same act for the removal of Bulkhead rock in this river, is insufficient for its removal to the required depth (23 feet), and it is proposed to reserve it until a further appropriation is made for continuing the improvement of the river, when its removal may be undertaken.

The amount required for continuing the improvement during the next fiscal year is $100,000.

Newport Harbor, Rhode Island.

Nothing has been done here during the past fiscal year, and no work is contemplated during the next.

Block Island Harbor, Rhode Island.

During the fiscal year there have been 25,227 tons of rip-rap granite put into the break-water, and 517 tons of bowlders removed from the anchorage sheltered by it.

The break-water now extends out 1,425 feet from the shore. A detached piece 300 feet in length has been built from a point 200 feet from the head or outer end of the main work.

A contract has been made for completing the work with the above dimensions, with the available funds. When this is done the harbor for local purposes will be completed. No further appropriation is asked for this work.

Pawcatuck River, Rhode Island and Connecticut.

No work has been done here during the past fiscal year and none is contemplated during the next.

Little Narragansett Bay, Rhode Island and Connecticut.

The improvement in this bay was begun during the fiscal year, and 4,015 cubic yards of material, including bowlders of a size less than one cubic yard, were removed by contract at a cost of thirty cents per cubic yard, and 69 cubic yards of bowlders exceeding one cubic yard in size at a cost of $5 per cubic yard. There were also removed by hired labor 131 cubic yards of dangerous rocks.

The estimated cost of the projected improvements is $51,000, of which $15,000 has been appropriated, leaving $36,000 still to be appropriated to complete this work.

This improvement is designed to make a safe channel through the shoals where the ruling depth is now 4½ feet at mean low water, of not less than 7½ feet at mean low water, and 200 feet width. The mean range of the tide is about 2½ feet.

The United States Advisory Council is still composed of Rear Admiral Daniel Ammen, U. S. N., Brevet Major-Gen. G. K. Warren, U. S. A. and Prof. Henry Mitchell, U. S. C. S.

We have consulted at intervals during the year with the members of this board, in addition to the formal interviews detailed in our last annual report, and have received counsel and assistance which we deem to be of great value to the State.

Respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS, } *Harbor Commissioners.*

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APPENDIX.

A.

COMMUNICATION TO GEN. G. K. WARREN.

PROVIDENCE, July 31, 1878.

To Gen. G. K. Warren, United States Engineers, Newport, R. I.:

DEAR SIR: In response to your communication requesting an expression of opinion by this board upon the question of the improvement of Providence Harbor, we respectfully submit the following statement:

It is provided in Chapter 611 of the Public Laws, as follows: "Section 4. The Harbor Commissioners are authorized and empowered, whenever they deem it necessary, to apply to Congress for appropriations for protecting and improving any harbor in the State." It is also provided that the Harbor Commissioners shall have the general care and supervision of all the public harbors and tide waters within this State, and it is their duty to make such investigations as are necessary to protect and develop the rights and interests of the State in such harbors and public waters; and to recommend legislation for the preservation and improvement of the harbors and public tide waters and the promotion of the interests of the State connected therewith. The Harbor Commissioners therefore are the recognized representatives of the State in all matters relating to the public tide waters in which the General Government and the State are jointly interested, and it is their especial duty to promote the improvement of these waters for public use.

Recognizing this duty, the Harbor Commissioners gave their early and careful attention to the improvement of the channels, and in connection with the United States Advisory Council, appointed by the President to coöperate with this board, they devised such improvement as seemed necessary for the safety and convenience of commerce in passing between the sea and Providence Harbor. Having done this, they petitioned Congress "to make an appropriation for the removal of obstructions, so that vessels of the larger class may find convenient and safe passage to this important harbor." It was estimated that the cost of doing this work would amount to about half a million dollars. The petition, supported by your able report upon the matter, ultimately resulted in an appropriation of $50,000 for the commencement of the work.

It was supposed by the Harbor Commissioners that this money would be expended at your discretion, under the broad language of our petition, so that the immediate results should be as beneficial as possible to the passage of vessels of the larger class. The only conditions which might control the language of the petition, so far as we are aware, are contained in the Senate Ex. Doc. No. 34, 45th Congress, 2d session, in which you report to the Chief of Engineers: "The first improvement to be undertaken is to make the deep channel for ocean steamers from Providence to the sea, and let the widening for anchorage and for a beating channel for sailing vessels follow. For making such a channel 200 feet wide and 23 feet deep at mean low-water, I have estimated would require," etc. You, however, refer to a communication to you by the Harbor Commissioners, which is appended to your report and printed as a part of the same in which they say the improvement "demanded by the interests and for the safety of commerce would be accomplished, first, by widening and deepening the main channel from Fox Point * * to Field's Point." A width of 1,060 feet and a depth of 23 feet are mentioned.

But, subsequent to the printing of this document, and before an appropriation was reported upon in Congress, the House Committee on Commerce to whom the matter had been referred, gave to representatives of the Harbor Commission, the Board of Trade, the city of Providence, and prominent business men of the State, a hearing upon the subject, at which the needs of commerce were explained, and the requirement for immediate relief to accommodate vessels now visiting the port and needing slightly greater depth than now exists was dwelt upon.

We had therefore supposed that the object of Congress in making the appropriation was mainly that stated at this hearing, and was that of beginning the improvement contemplated as a whole, by an expenditure which should give immediate relief so far as possible.

This relief can, in our opinion, be best accomplished by making a channel from 200 to 300 feet wide and about 20 feet deep at low water. Such a channel would be wide enough to be safely navigated by vessels of deep draught, if few in number, and it would be deep enough for the large ocean steamers, during about half of every tide.

We suppose that such a width and depth can be secured, with the appropriation now available, and we believe its expenditure in this way would receive the hearty approval of nearly all the business men of this community.

The Harbor Commissioners would approve of the dumping of excavated material on either side of Providence Harbor at a suitable distance within the harbor lines, or in deep water near Sand Point, east of Prudence Island.

Respectfully yours,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

B.

ABSTRACT OF REPORT OF GEN. G. K. WARREN, TO CHIEF OF U. S. ENGINEERS, FOR 1878.

Improvement of Pawtucket or Seekonk River, Rhode Island.

No work has been done in this river during the past fiscal year. The remainder of the last appropriation is reserved to deepen certain shoals which are reforming, or for the removal of any accidental obstruction.

For a history of this work see Annual Reports of the Chief of Engineers for 1874, Part 2, page 227; and for 1876, Part 1, page 207.

Pawtucket River is in the Providence collection district, and that place is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1878, was $171,553.79.

MONEY STATEMENT.

July 1, 1877, amount available	$1,511 28
July 1, 1878, amount expended during fiscal year	127 75
July 1, 1878, amount available	1,383 53

Improvement of Providence River and Narragansett Bay, Rhode Island.

Providence River is an estuary extending from Nayat Point, Narragansett Bay, to Providence. Its length is about 7 miles, with a width varying from 1,000 feet to 2 miles, and a depth from 12 to 50 feet at mean low water. At its head this estuary is joined by another called the Seekonk or Pawtucket, extending 4 miles further to the town of Pawtucket. Providence has upward of 100,000 inhabitants, with large manufacturing and commercial industries. The legislature of the State has established Harbor lines as far down as Field's Point, about 5¼ miles above Nayat Point. The parts above Field's Point are called Providence Harbor. From Providence to the sea is about 28 miles, with ample width and depth below Nayat Point for the movement or anchorage of any number of the largest vessels.

The improvement sought is for a channel—

23 feet deep at mean low-water, 150 feet wide.
20 feet deep at mean low-water, 600 feet wide.
18 feet deep at mean low-water, 725 feet wide.
12 feet deep at mean low-water, 940 feet wide.
6 feet deep at mean low-water, 1,060 feet wide.

The general government has expended about $56,500 in the improvement of this harbor between Fox Point and Field's Point, making a depth of 12 feet at mean low water. In addition to this amount the city of Providence has expended upward of $90,000 in dredging the harbor, mainly above Fox Point.

Under date of February 18, 1878, I made a report in regard to the improvement of Providence Harbor and the channels of approach to it. This report was printed as Sen. Ex. Doc. No. 34, Forty-fifth Congress, second session, and is part of this report.

By act of Congress approved June 18, 1878, $50,000 was appropriated for the improvement of this river and bay. This it is proposed to expend in dredging a channel 23 feet deep in the shoalest part of the present channel, the work to be done by contract after advertising in the usual mannar. By the same act of Congress $5,000 was appropriated for the removal of Bulkhead Rock. This rock is on the side of the deep channel of the river, about 2½ miles below Fox Point. It lies in the path of vessels beating in or out of the river, and should be removed. In my former reports upon this obstruction I have estimated for its removal to a depth of 18 feet at mean low-water, at a cost of $5,000. At that time 18 feet was the governing depth, but with the depths of the proposed channel this should be removed down level with the bottom, about 20 feet at mean low water. To do this will probably cost $10,000, and as it can be done cheaper by making the depth required at once, it is thought advisable to reserve the present amount until another appropriation for the river is made, when the work can all be done at once.

Providence is in the Providence collection district, and that place is a port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1878, is $171,553.79.

MONEY STATEMENT.

Improvement of Providence River and Narragansett Bay.

Amount appropriated by act approved June 18, 1878	$50,000 00
July 1, 1878, amount available	50,000 00
Amount (estimated) required for completion of existing project	450,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1880	100,000 00

Improvement of Providence River—Removal of Bulkhead Rock.

July 1, 1877, amount available	$74 98	
Amount appropriated by act approved June 18, 1878	5,000 00	
		5,074 98
July 1, 1878, amount expended during fiscal year		74 98
July 1, 1878, amount available		5.000 00

*Special Report on Improvement of Providence River and Narragansett Bay, Rhode Island.**

OFFICE OF THE CHIEF OF ENGINEERS,
WASHINGTON, D. C., February 25, 1878.

SIR: I beg leave respectfully to return herewith the resolution of the Senate of the United States of the 31st January last—

> That the Secretary of War be directed to furnish to the Senate any information in his department relative to the improvement of Providence River and Narragansett Bay, with an estimate of the cost of such improvement.

And, in obedience to its requirements, to submit the inclosed copy of a report on the subject from Maj. G. K. Warren, Corps of Engineers, to whom it was referred. This report is very full, and conveys all the information contemplated by the resolution.

It will be seen that the improvement which, in the opinion of the Harbor Commissioners of the State of Rhode Island, is demanded by the interests of commerce, consists in making a channel of 23 feet in depth at mean low water from Providence to the sea, and they estimate that the whole amount of dredging required for this purpose will be about 3,501,640 cubic yards, at a cost of $500,234.29. In this estimate no allowance for rock-excavation is made, though it will in all probability be in some places required.

The order in which the work of improvement should be executed is, in Major Warren's opinion, first, to make the deep channel for ocean steamers from Providence to the sea; then to proceed with the work of widening the channel, &c.

The cost of this deep channel he estimates at $100,000, and deems it to be in the interest of economy to appropriate the whole sum at once.

I concur in Major Warren's views.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier-General and Chief of Engineers.

HON. GEO. W. MCCRARY,
Secretary of War.

REPORT.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., February 18, 1878.

GENERAL: I have the honor to submit the following report in obedience to your letter of instructions, of February 2, transmitting a copy of the resolution of the United States Senate, made on January 31, and also in obedience to your letter of February 7, transmitting a resolution of the United States House of Representatives, passed on February 5, both in regard to the improvement of Providence Harbor, Rhode Island, and the channels of approach to it.

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* Printed as Sen. Ex. Doc. 34, Forty-fifth Congress, second session.

The House resolution requires a report " based on examinations and surveys made by the Coast Survey or other departments of the Government," which, as far as I know, are as follows:

In the year 1872, under an act of Congress, I made a survey from Fox Point to Field's Point (see Annual Report of Chief of Engineers for 1873, page 969), and estimated the cost of dredging off the point of Long Bed, for which $10,000 was appropriated, and the point dredged off in the summer of 1873.

In 1874 the United States Coast Survey made a new survey which also covered this portion of the harbor, and a copy of the map was furnished the Rhode Island Board of Harbor Commissioners, which copy I have consulted. There is as close agreement in the result of the two surveys as could be expected, so that, as a basis for an estimate of quantity of material to be removed in this part, nothing more is desired. There is some uncertainty as to the amount of rock that may be encountered, but this cannot be definitely determined except as the dredging is being carried on.

During the past summer, upon application of the Governor of Rhode Island, the President of the United States appointed Rear-Admiral Daniel Ammen, Chief of the Bureau of Navigation, United States Navy, Prof. Henry Mitchell, United States Coast Survey, and myself, members of an advisory council to the Board of Harbor Commissioners of Rhode Island, and this council had several meetings with the Harbor Commissioners to consider the improvement of Providence River and Harbor. The harbor proper is taken to comprise the part between Fox Point and Field's Point, a distance of about 8,800 feet. Through about 2,800 feet of this there is ample channel depth. Through the other 6,000 feet the depth, in places, shoals to 14 and 15 feet, and at the upper end to 12 feet at mean low water. This limits the size of the vessels that can reach the present wharves. The mean rise of the tide is about 4½ feet. In regard to the improvement of this portion the Advisory Council give the following opinion to the Harbor Commissioners:

> In a port like Providence, employed for miscellaneous commerce, the greatest good to the greatest number is to be secured by a channel of 18 feet depth at low tide. In order, however, not to exclude vessels of greater draught, we recommend that the channel should have a central pathway of 23 feet depth, 150 feet wide.
>
> The form of channel that would meet these requirements and have the most permanent slopes, would have the following widths, naturally, between its contours in light alluvium:
>
> 23 feet depth, 150 feet wide.
> 20 feet depth, 600 feet wide.
> 18 feet depth, 725 feet wide.
> 12 feet depth, 940 feet wide.
> 6 feet depth, 1,060 feet wide.
>
> We recommend that this channel should be carried from the city to Field's Point, following generally the present channel below Fox Point; and using the above table as a guide as far as possible for computing the amount of material to be removed (and not as a convenient plan of dredging), we find from the origi-

nal hydrographic sheet of the Coast Survey (1326 A), executed in 1874, that the necessary dredging would then have been two and one-quarter millions of cubic yards, bank measurement.

The average length of vessels likely to seek this harbor, if improved, may be set down at 150 feet, and these, with average draught of 18 feet, would require 54 feet of cable, giving her radius of swing room 202 feet. These vessels, anchored most carefully on both sides of the channel proposed, would leave 321 feet gangway for the passage of other vessels. If anchored with only the ordinary care (but still under supervision of a harbor-master) the width of the gangway would sometimes not exceed 150 feet. It is assumed that so few vessels of extraordinary draught would be in port at the same time that the harbor-master could so arrange them as to avoid having any two of them in the same section. It is proper to regard the vessels as lying transversely to the direction of the channel, because during the season when the largest fleet visits this port winds from the west-southwest and southwest prevail.

In providing for anchorage-room on either side of the gangway rather than excavating a special basin for anchorage, it has been borne in mind that the whole channel in the absence of vessels at anchor will be useful for the passage of vessels under sail, and that this channel traversed by tidal currents will be less likely to freeze up than a sheltered basin, or more easily broken out when frozen.

* * * * * * * *

The Harbor Commissioners have also made an estimate of the amount of material to be removed to make a channel 23 feet deep at mean low water, and 400 feet wide, with an additional width each side of 200 feet, gradually shoaling up to a depth of 10 feet at mean low water. The amount is 1,421,720 cubic yards. But in their communication to me dated February 8, transmitted herewith, they adopt the plan and estimate of the Advisory Council.

In order to secure the depth of 23 feet at mean low water below Field's Point, dredging must be done at Pawtuxet Shoal and at Gaspee Shoal.

The Harbor Commissioners' estimate for the amount to be removed at these two places, is upon the design to make the channel 23 feet deep and 400 feet wide and 200 feet each side, shoaling up to 10 feet.

At Pawtuxet Shoal, cubic yards	733,686
At Gaspee Shoal, cubic yards	46,000

In order to allow vessels to enter and leave Providence direct by the western entrance to Narragansett Bay, drawing 23 feet at mean low water, another shoal must be removed just above Rocky Point, which the Harbor Commissioners estimate to amount to 424,824 cubic yards. Vessels using the middle entrance to Narragansett Bay, would not have to pass this shoal near Rocky Point. The foregoing quantities are bank measurements; measured in scows, the quantity would be increased by one-third.

To recapitulate, we have now the following estimates of quantities:

ESTIMATE OF ADVISORY COUNCIL.

Fox Point to Field's Point, cubic yards, bank measurement	2,250,000
Fox Point to Field's Point, cubic yards, measurement in scow	3,000,000
Cost	$428,571

ESTIMATES OF HARBOR COMMISSIONERS.

Fox Point to Field's Point, cubic yards	1,421,720
Pawtuxet Shoal, cubic yards	733,686

Gaspee Shoal, cubic yards	46,000
Rocky Point, cubic yards	424,824
Total bank-measurement	2,626,230
Total measurement in scow	3,501,640
Cost	$500,234 29

No rock is included in the foregoing estimates, and although some will undoubtedly have to be removed, as, for instance, Bulkhead Rock, this is comparatively a small item. This improvement, when made, will be permanent.

The improvement desired will, at present prices, cost about $500,000. The importance of doing this is so well set forth in the accompanying communication made to me by the Board of Harbor Commissioners that I have nothing to add on this point.*

The first improvement to be undertaken is to make the deep channel for ocean steamers, from Providence to the sea, and let the widening for anchorage and for a beating-channel for sailing vessels follow. For making such a channel 200 feet wide and 23 feet deep at mean low water I have estimated would require:

From Fox Point to Field's Point, 434.000 cubic yards, measured in scows.
At Pawtuxet and Gaspee Shoal, 175,000 cubic yards, measured in scows.

609,000 cubic yards, measured in scows.

At $1 for 7 yards, this would cost	$87,000
Add for removal of rocks and superintendence	13,000
	$100,000

To cut through the shoal near Rocky Point 200 feet wide and 23 feet deep at mean low water would require the removal of 300,000 cubic yards, measured in the scows; and inasmuch as this shoal can be avoided by using the middle entrance to the bay, it is not an important obstruction. It now has a ruling depth of 18 feet at mean low water.

All the estimates below Field's Point are based solely upon the United States Coast Survey charts, on one of which, sent herewith, the proposed channel is marked.

If the revenue of the Government will allow such an expenditure in one year it would be best to appropriate the sum of $100,000 in one year, so that the benefit may be at once obtained.

Providence is in the Providence collection district, and is a port of entry. The revenue from customs, during the fiscal year ending June 30, 1876, was $182,352.57.

The United States in former years has expended about $56,500 on improvement of this harbor.

Very respectfully,
G. K. WARREN,
Major of Engineers, Brevet Major-General, U. S. A.

BRIG. GEN. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

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* This communication was printed in the Second Annual Report of the Harbor Commission.

Newport Harbor, Rhode Island.

Nothing has been done here during the past fiscal year, and no work is contemplated during the next.

Block Island Harbor, Rhode Island.

During the fiscal year there have been 25,227 tons of rip-rap granite put into the break-water, and 517 tons of bowlders removed from the anchorage sheltered by it.

The break-water now extends out 1,425 feet from the shore. A detached piece 300 feet in length has been built from a point 200 feet from the head or outer end of the main work.

A contract has been made for completing the work with the above dimensions, with the available funds. When this is done the harbor for local purposes will be completed. No further appropriation is asked for this work.

Pawcatuck River, Rhode Island and Connecticut.

No work has been done here during the past fiscal year and none is contemplated during the next.

Little Narragansett Bay, Rhode Island and Connecticut.

The improvement in this bay was begun during the fiscal year, and 4,015 cubic yards of material, including bowlders of a size less than one cubic yard, were removed by contract at a cost of thirty cents per cubic yard, and 69 cubic yards of bowlders exceeding one cubic yard in size at a cost of $5 per cubic yard. There were also removed by hired labor 131 cubic yards of dangerous rocks.

The estimated cost of the projected improvements is $51,000, of which $15,000 has been appropriated, leaving $36,000 still to be appropriated to complete this work.

This improvement is designed to make a safe channel through the shoals where the ruling depth is now 4½ feet at mean low water, of not less than 7½ feet at mean low water, and 200 feet width. The mean range of the tide is about 2½ feet.

The United States Advisory Council is still composed of Rear Admiral Daniel Ammen, U. S. N., Brevet Major-Gen. G. K. Warren, U. S. A. and Prof. Henry Mitchell, U. S. C. S.

We have consulted at intervals during the year with the members of this board, in addition to the formal interviews detailed in our last annual report, and have received counsel and assistance which we deem to be of great value to the State.

Respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS, } *Harbor Commissioners.*

Improvement of Pawcatuck River, Rhode Island and Connecticut.

No work has been done here during the past fiscal year, and none is contemplated during the next. The small amount of funds available at the beginning of the year has been expended in closing up the work and in office expenses.

MONEY STATEMENT.

July 1, 1877, amount available	$101 97
July 1, 1878, amount expended during the fiscal year	101 97

Improvement of Little Narragansett Bay, Rhode Island and Connecticut.

This bay lies between Stonington, in the State of Connecticut, and Watch Hill, in Rhode Island. It is entered from Fisher's Island Sound, and it receives the waters of Pawcatuck River, at the head of navigation of which are the flourishing towns of Pawcatuck, Conn., and Westerly, R. I., with their mills and fine granite quarries. The general government has already dredged a channel-way in the river up to these towns, 75 feet wide, 5½ feet deep at mean low-water, and 8 feet deep at mean high-water. The entrance to the bay is deep, but a shoal extends all across its wider portion, which cannot be passed at mean low-water with vessels drawing more than 4½ feet or 7 feet at mean high water, and it was besides obstructed with dangerous rocks. The bay was surveyed by authority of the general government in 1875, and is reported on, with project for improvement, in Annual Report of Chief of Engineers for 1876, Part 1, pp. 217–221. The project was for a channel 7½ feet deep at mean low water, and 200 feet wide, together with the removal of the dangerous rocks. The reason for making it deeper than the channel made in the river is to enable vessels to pass it in the earlier stages of the tide, and thus insure reaching Westerly on the crest of the tide-wave. The estimated cost was $51,000.

The act of Congress approved August 14, 1876, appropriated $5,000 to begin this improvement, but the expenditure was not ordered until May, 1877. Of this amount $1,500 was set aside for superintendence and for removing dangerous rocks near Rhodes' Folly by hired labor, and $3,500 for making the proposed channel near Pawcatuck Point, by contract with the lowest responsible bidder. Pawcatuck Point was selected because part of the material to be removed from the place was known to be bowlders, while all the other parts were soft digging. It was desirable to test the feasibility of the whole plan at once by operations upon the most difficult part. There was the additional reason that if a channel were opened here it would be available with nearly as much water in other parts as the route heretofore used and with better steering ranges and less dangers.

It is reported in the last annual report (Part 1, page 204) that the contract had been awarded to W. H. Molthrop, of New London, Conn., to remove the material, including bowlders of a size not exceeding one cubic yard, at the rate of 30 cents per cubic yard, and all bowlders of a greater size at the rate of $5 per cubic yard.

The dangerous rocks near Rhodes' Folly having upon them a less depth than 7½ feet at mean low-water, have all been removed by hired labor. The amount was 131 cubic yards. One rock weighing, probably, 150 tons, had to be blasted, and the pieces, as well as the other rocks, were lifted by scows under the action of the rising tide.

Work near Pawcatuck Point was begun July 4, 1877, by a very poor dredging machine, which two days after hauled off for repairs. Another dredge was obtained September 24, and this continued until December 17, when work was abandoned for the winter. The time of completion was extended from November 30, 1877, to June 30, 1878. The dredge resumed work on the 3d of June and continued till the 17th of that month, when her boiler burst, fortunately without serious injury to the crew. Nearly all the work had now been done that the funds would pay for, and the object of testing the character of the excavation having been accomplished, I regarded the contract as completed.

Two cuts, having a combined width of 84 feet, have been made across the shoal at the point, and another cut about one-third of the way in the part where the dredging is easiest. A ridge of bowlders was encountered running across the new channel, having a width of about 50 feet. About half of these were larger and the other half smaller than one cubic yard. About 69 cubic yards of the large size were removed at $5 per yard. The other material removed amounted to 4,015 cubic yards at 30 cents.

The new channel is too narrow to be of any use as yet. It is proposed to expend the appropriation of $10,000, approved June 18, 1878, along with the remainder of the former appropriation, in completing the channel opposite to Pawcatuck Point to the width of 200 feet and depth of 7½ feet at mean low-water, and to commence the deepening of the channel west of this, if there is money enough.

The original estimate was for $51,000, of which $15,000 has been appropriated. The remainder, $36,000, is asked for the next fiscal year.

This improvement is in both the collection districts of Providence, R. I., and Stonington, Conn. The revenue collected at the first named during the last fiscal year is $171,553.79.

In October and November, 1877, a set of tide observations was made to verify the mean low water plane at Watch Hill, established in making the survey in 1875. The difference in the mean rise and fall of tide was $\frac{8}{100}$ foot.

The bench-mark at Pawcatuck Point, to which mean low water is referred, is a bolt in the south face of the largest bowlder on the southwest side of Pawcatuck Point, at the low water line. It is 3.07 feet above mean low water. Simultaneous observations were made at Westerly and Pawcatuck Point to get a mean low water for the upper part of the Pawcatuck River, the bench-mark to which the old mean low water plane was referred having been carried away by ice. The new bench-mark is the top of the cap-log at southeast corner of Cottrell and Babcock's Wharf, Pawcatuck.

It is marked [B M], and is 5.19 feet above mean low-water. This improvement has been superintended by Mr. H. A. Bentley, Assistant Engineer.

The following is a table of observations made at Pawcatuck Point:

Date.	High-water.	Low-water.	Date.	High-water.	Low-water.
1878.	*Feet.*	*Feet.*		*Feet.*	*Feet.*
October 20	10.60	8.0	November 3	10.30	7 10
October 21	10.90	8.10	November 4	9.60	6.70
October 22	10.70	8.20	November 5	10.90	7.40
October 23	11.70	7.80	November 6	10.80	6.70
October 24	10.30	7.80	November 7	10.50	7.00
October 25	11.00	7.90	November 8	10.70	7.80
October 26	11.60	8.50	November 9	10.80	8.10
October 27	10.90	8.00	November 10	10.20	8.00
October 28	10.50	8.20	November 11	10.70	8.80
October 29	10.40	8.30	November 12	10.20	8.70
October 30	10.10	8.00	November 13	10.00	8.50
October 31	11.10	8.20	November 14	9.80	8.20
November 1	10.70	8.0	November 15	9.70	7.80
November 2	11.10	8.50	November 16	9.80	8.00

Mean rise and fall of tide 2.63 feet.

MONEY STATEMENT.

July 1, 1877, amount available	$ 5,000 00	
Amount appropriated by act approved June 18, 1878	10,000 00	
		$15,000 00
July 1, 1878, amount expended during fiscal year		4,320 62
July 1, 1878, amount available		10,679 38
Amount (estimated) required for completion of existing project		36,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1880		36,000 00

C.

PROCEEDINGS OF THE CITY COUNCIL OF PROVIDENCE IN RELATION TO THE HARBOR LINE AT FIELD'S POINT.

No. 67. Message of the Mayor, relative to the widening of the channel at Field's Point.

[Presented February 10, 1879.]

CITY OF PROVIDENCE, EXECUTIVE DEPARTMENT,
CITY HALL, February 10, 1879.

Gentlemen of the City Council:

I transmit herewith copy of a communication received from the Board of Harbor Commissioners, in relation to the widening of the channel at Field's Point, by removing a portion of the point. The Board desires the co-operation of the city council in the matter of fixing a proper harbor line from Sassafras Point to Field's Point, which will require a decision of the question as to widening the channel, as already stated.

The improvement of the harbor is one of the most important subjects that can demand the attention of the City Council. I therefore most earnestly recommend that prompt action be taken upon the communication of the Commissioners, and that the efforts for the removal of the sand spit at Field's Point may receive the full approval and assistance of the City Council.

THOMAS A. DOYLE,
Mayor.

PROVIDENCE, February 4, 1879.

Hon. Thomas A. Doyle, Mayor:

DEAR SIR: The Harbor Commissioners have under consideration the establishment of a harbor line from Sassafras Point to Field's Point. The position of the long, low spit of land jutting out into the channel at Field's Point, and its effect upon the direction of the current, which in its turn affects the ship channel, has led to a consideration of the question as to cutting off this sand spit, and thus widening the mouth of the harbor and improving the course of the channel.

This matter is regarded as of considerable importance, and we wish to call the attention of the city government to it, with a view of securing such action on the part of the city as will result in the establishment of the harbor line in that position which shall appear to be for the best interests of the community.

Very respectfully yours,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

No. 68. Resolution referring the Mayor's Message, relative to the widening of the channel at Field's Point.

[Approved February 13, 1879.]

Resolved, That the Mayor's message dated February 10, 1879, in relation to the widening of the channel at Field's Point, and the fixing of a proper harbor line from Sassafras Point to Field's Point, be referred to the joint committee on the harbor to examine and report thereon.

No. 85. Resolution approving proposed harbor line at Field's Point.

[Approved February 13, 1879]

Resolved, That the City Council hereby approves the line proposed by the harbor commissioners for a harbor line at Field's Point, and will devote to the improvement of the harbor so much of said point as lies easterly of said line.

D.

CONTRACT BETWEEN THE CITY OF PROVIDENCE AND THE HARBOR COMMISSIONERS.

Know all Men by these Presents: That the City of Providence, a municipal corporation in the State of Rhode Island, in consideration of the license granted to said city by the Harbor Commissioners of said State to construct an embankment, protected by a rip-rap wall, on the west side of Seekonk river, northerly from Front street, a copy of which license is hereto annexed, marked "A," and made part hereof, does hereby agree to and with said Harbor Commissioners, a board now composed of J. Herbert Shedd, Nathaniel F. Potter and Jedediah Williams, and their successors in said offices, to dredge from said Seekonk river, or from the harbor of Providence river, at such points as said Harbor Commissioners should select, and in a manner satisfactory to said Harbor Commissioners, as many cubic yards of material as shall be displaced by the construction of said work. And it is further agreed by said city and said Harbor Commissioners that the amount of such displacement shall be ascertained by a competent engineer, to be selected by said city and said Harbor Commissioners, as follows: Accurate measurements of the present surface of the work in the locality where said work is to be done shall be taken, and an accurate account of the quantity of material put into said work is to be kept, and on the completion of said work to the satisfaction of said Harbor Commissioners an accurate measurement of the position of the surfaces of said work is to be taken, and the contents of the figure lying between the surfaces now existing and the surfaces of the completed work is to be estimated and the difference in volume between the size of said figure so estimated as aforesaid, and the amount of material which shall be put into said work is to be considered the measure of the material which has been displaced by the construction of the work aforesaid, and as the measurement of the amount of dredging to be done as aforesaid under the direction of said Harbor Commissioners.

And the said city of Providence hereby agrees to and with said Board of Harbor Commissioners to do the said dredging to the amount so ascertained as aforesaid, at the times and places aforesaid, under the direction of and in a manner satisfactory to said board of Harbor Commissioners.

In witness whereof the said city of Providence has caused this agreement to be signed by Thomas A. Doyle, Mayor, their agent thereto, duly authorized this second day of March, A. D. 1878.

[L. S.] The City of Providence, by

THOMAS A. DOYLE, *Mayor.*

Correct in form,

N. VAN SLYCK, *City Solicitor.*

Approved by Committee,

THOS. A. MILLETT, *Chairman.*

ATTORNEY GENERAL'S OFFICE, August 21, 1878.

Approved,

W. SAYLES, *Attorney General.*

"A."

Whereas, The city of Providence, through its committee on Brook street district, has made written application to this board for a license to construct an embankment protected by a rip-rap wall on the west side of Seekonk river, northerly from Front street, and have submitted plans and specifications of the same.

Now, therefore, The said city of Providence is hereby authorized to proceed and build said embankment in conformity to plans and specifications filed in this office, except that the slope wall shall be located thirty feet westerly and farther back from the harbor line than is shown upon said plans; and, *Provided,* That the city of Providence execute an agreement satisfactory to the Attorney General, to the effect that said city shall dredge from the channels of the river or harbor, at such points as the Harbor Commissioners may select, and in a manner satisfactory to them, as many cubic yards of material as shall be displaced by the construction of said work. The amount of said displacement to be ascertained by a competent engineer, as follows: Accurate measurements of the present surface of the earth in said locality are to be taken. An accurate account of the quantity of material put into said work is to be kept. On completion of the work in a manner satisfactory to the Harbor Commissioners, an accurate measurement of the position of the surfaces is to be taken and the contents of the figure lying between the surfaces now existing and the surfaces of the completed work, is to be estimated. The difference in volume between this estimated figure and the amount of material put into the work is to be considered the measure of the material which has been displaced by the construction of the work, and consquently the amount of dredging to be done under direction of the Commissioners.

This license to be of no effect until said agreement has been executed.

In witness whereof the Board of Harbor Commissioners have hereto affixed their signatures this second day of March, A. D. 1878.

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

E.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.

Wednesday, September 4.						*Thursday, September 5.*					
Box No 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
						A. M.		A. M.		A. M.	
						***3.05*	*6.65*	***3.10*	*6.68*	***3.20*	*6.76*
						5.20	8.65	5.23	8.61	5.30	8.50
						5.40	8.86	5.43	8.81	5.50	8.80
						6.00	9.18	6.03	9.10	6.10	9.07
						6 20	9.41	6 23	9.36	6.30	9.30
						6.40	9.68	6.43	9.65	6.50	9.60
						7 00	9.89	7.03	9.80	7.10	9.78
						7.20	9.90	7.23	9.87	7.30	9.84
						7.40	10.10	7.43	10.06	7.50	10.06
						8.00	10.16	8.03	10.12	8.10	10.14
						8.20	*10.20*	*8.23*	*10.15*	*8.30*	*10.17*
						8.40	10.12	8.43	10.10	8.50	10.13
						9.00	10.05	9.03	9.95	9 10	9.96
						9.20	9.71	9.23	9.71	9.30	9 75
						9.40	9.50	9.43	9.49	9.50	9.55
						10.00	9.25	10.03	9.29	10.10	9.32
						10.20	9.04	10.23	9.10	10.30	9.12
						10.40	8.97	10.43	8.97	10.50	8.97
						11.00	8.95	11.03	8.93	11.10	8.93
						11.20	8.92	11.23	8 90	11.30	8.91
						11.40	8.90	11.43	8.91	11.50	8.95
P. M.		P. M.		P. M.		P. M.		P. M.		P M.	
12.30	7.67	12.25	7.88	12.15	8.14	12.00	8.93	12.03	8.87	12.10	8.87
12.55	7.05	12.50	7.31	12.40	7.69	12.20	8.68	12.23	8.64	12.30	8 63
1.20	6.51	1.15	6.74	1.05	7.15	12.40	8.32	12.43	8.34	12.50	8.40
1.45	6.15	1.40	6.30	1.30	6.59	1.00	8.04	1.03	8.09	1.10	8.10
2.10	5.91	2.05	6.03	1.55	6.23	1.20	7.58	1.23	7.62	1.30	7.67
2.35	*5.88*	*2.30*	*5.88*	2.20	5.95	1.40	7.17	1.43	7.23	1.50	7.33
3.00	6.00	2.55	5.92	*2.45*	*5.84*	2.00	6.87	2.03	6.91	2.10	6.92
3.25	6.43	3.20	6.23	3.10	6.05	2.20	6.57	2.23	6.58	2.30	6.60
3.50	6.92	3.45	6.77	3.35	6.43	2.40	6.21	2.43	6.26	2.50	6.26
4.15	7.45	4.10	7.24	4.00	6.84	*3.00*	*5.92*	*3.03*	*5.97*	*3.10*	*6.03*
4.40	7.98	4.35	7.79	4.25	7.35	3.20	6.14	3.23	6.13	3.30	6.19
5.05	8.49	5.00	8.28	4.50	7.82	3.40	6.41	3.43	6.37	3.50	6.31
5.30	8.90	5.25	8.75	5.15	8.29	4.00	6.57	4.03	6.54	4.10	6.55
5.55	9.17	5.50	9.01	5.40	8.68	4.20	6.82	4.23	6.78	4.30	6.81
6.25	9.65	6.03	9.27	6 15	9.24	4.40	7.01	4.43	6.99	4.50	7.03
6.45	9.85	6.30	9.62	6.37	9.51	5.00	7.21	5.03	7.15	5.10	7.23
***8.55*	*9.27*	6.50	9.85	6.57	9.79	5.20	7.41	5.23	7.37	5.30	7.41
		***9.00*	*9.29*	***9.07*	*9.33*	5.40	7.67	5.43	7.65	5.50	7.67
						6.00	8.03	6.03	7.97	6.10	7.99
						6.20	8.40	6.23	8.36	6.30	8.30
						6.40	8.71	6.43	8.67	6.50	8.59
						***9.21*	*9.97*	***9.26*	*9.93*	***9.34*	*9.91*

NOTE.—The times and readings at high and low-water are shown in italics.

* The readings marked thus were made by the police.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 6.						*Saturday, September 7.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
_*3.57_	_6.75_	_*4.02_	_6.77_	_*4.10_	_6.82_	_*5.05_	_6.63_	_*5.10_	_6.63_	_*5.17_	_6.68_
5.20	7.76	5.23	7.74	5.30	7.76	5.20	6.78	5 23	6.77	5.30	6.86
5.40	8.02	5.43	8.01	5.50	7.99	5.40	6.97	5.43	6.97	5.50	6.97
6.00	8.34	6.03	8.31	6.10	8.26	6.00	7.30	6.03	7.27	6.10	7.27
6.20	8 62	6.23	8.60	6 30	8.57	6.20	7.68	6.23	7.66	6.30	7.61
6.40	8.85	6.43	8.83	6.50	8.80	6.40	8.00	6.43	7.96	6.50	7.91
7.00	9.03	7.03	9.01	7.10	8.99	7.00	8.30	7.03	8.22	7.10	8.21
7.20	9.30	7,23	9.28	7.30	9.28	7.20	8.49	7.23	8.46	7.30	8.47
7.40	9.60	7.43	9.56	7.50	9.54	7.40	8.78	7.43	8.79	7.50	8.75
8.00	9.91	8.03	9.88	8.10	9.77	8.00	9.13	8.03	9.11	8.10	9.04
8.20	9.99	8.23	9.95	8.30	9.90	8.20	9.49	8.23	9.46	8.30	9.34
8.40	10.06	8.43	10.04	8.50	10.04	8.40	9.73	8.43	9.69	8.50	9.55
9.00	10.12	9.03	10.09	9.10	10.09	9.00	10.11	9.03	10.09	9.10	9.95
_9.20_	_10.15_	_9 23_	_10.10_	_9.30_	_10.13_	9.20	10.21	9.23	10.26	9.30	10.13
9.40	10.14	_9.43_	_10.10_	9.50	10.11	9.40	10.41	9.43	10.45	9.50	10.34
10 00	10.04	10.03	10.01	10.10	10.04	10.00	10.66	10.03	10.62	10.10	10.55
10.20	9.95	10.23	9.94	10.30	9.93	10.20	10.70	_10.23_	_10.75_	_10.30_	_10.70_
10.40	9.81	10.43	9.79	10.50	9.81	_10.40_	_10.74_	10.43	10.71	_10.50_	_10.70_
11.00	9.70	11.03	9.69	11.10	9.71	11.00	10.60	11.03	10.57	11.10	10.51
11.20	9.53	11.23	9.52	11.30	9.52	11.20	10.29	11.23	10.30	11.30	10.34
11.40	9.36	11.43	9.37	11.50	9.38	11.40	9.99	11.43	10.02	11.50	10.05
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	9.30	12.03	9.27	12.10	9.27	12.00	9.60	12.03	9.65	12.10	9.71
12.20	9.16	12.23	9.15	12.30	9.13	12.20	9.26	12.23	9.35	12.30	9.41
12.40	9.03	12.43	9.00	12.50	8.99	12.40	9.03	12.43	9.11	12.50	9.16
1.00	8.87	1.03	8.86	1.10	8.87	1.00	8.93	1.03	8.95	1.10	8.98
1.20	8.66	1.23	8.65	1.30	8.63	1.20	8.78	1.23	8.77	1.30	8.78
1.40	8.35	1.43	8.36	1.50	8.35	1.40	8.75	1.43	8.68	1.50	8.67
2.00	8.11	2.03	8.13	2.10	8.11	2.00	8.62	2.03	8.60	2.10	8.59
2.20	7.75	2 23	7.79	2.30	7.77	2.20	8.55	2.23	8.54	2.30	8.51
2.40	7.42	2.43	7.47	2.50	7.46	2.40	8.36	2.43	8.33	2.50	8.33
3.00	7.10	3.03	7.14	3.10	7.11	3.00	8.12	3.03	8.14	3.10	8.13
3.20	6.75	3.23	6.81	3.30	6.82	3.20	7.85	3.23	7.88	3.30	7.88
3.40	6.47	3.43	6.53	3.50	6.52	3.40	7.61	3.43	7.60	3.50	7.60
4.00	6.29	4.03	6.32	4.10	6.29	4.00	7.20	4.03	7 23	4.10	7.21
_4.20_	_6.20_	_4.23_	_6.21_	_4.30_	_6.20_	4.20	6.80	4.23	6.85	4.30	6.87
4.40	6.25	_4.43_	_6.21_	4.50	6.27	4.40	6.50	4.43	6.55	4.50	6.56
5.00	6.43	5.03	6.43	5.10	6.43	5.00	6.30	5.03	6.35	5.10	6.34
5.20	6.67	5.23	6.65	5.30	6.65	5.20	6.24	5.23	6 25	5 30	6.25
5.40	6.92	5.43	6.91	5.50	6.89	_5.40_	_6.20_	5.43	6.19	_5.50_	_6.20_
6.00	7.11	6.03	7.09	6.10	7.13	6.00	6.21	_6.03_	_6.17_	6.10	6.25
6.20	7.35	6.23	7.36	6.30	7.37	6.20	6.27	6.23	6.30	6.30	6.35
6.40	7.55	6.43	7.61	6.50	7.61	6.40	6.45	6.43	6.45	6.50	6.50
_*10.20_	_10.12_	_*10.75_	_10.09_	_*10.31_	_10.08_	_*11.05_	_10.22_	_*11.18_	_10.16_	_*11.26_	_10.14_

*Sunday, September 8, A. M.**						*Sunday, September 8, P. M.**					
_5.50_	_6.51_	_5.55_	_6.51_	_6.00_	_6.53_			_12.07_	_10.70_	_12.13_	_10.66_
_11,55_	_10.79_					_6.15_	_6.17_	_6.20_	_6.19_	_6.25_	_6.23_

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 9.						*Tuesday, September 10.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M		A. M.	
*0.15	*10.63*	*0.20	*10.60*	*0.25	*10.58*	*1.15	*10.48*	*1.24	*10.43*	*1.29	*10.41*
5.20	7.27	5.23	7.35	5.30	7.39	5.20	7.71	5.23	7.77	5.30	7.81
5.40	6.97	5.43	7.03	5.50	7.02	5.40	7.36	5.43	7.43	5.50	7.45
6.00	6.59	6.03	6.66	6.10	6.70	6.00	7.06	6.03	7.10	6.10	7.14
6.20	6.46	6.23	6.50	6.30	6.51	6.20	6.72	6.23	6.78	6.30	6.81
6.40	*6.39*	*6.43*	*6.39*	*6.50*	*6.41*	6.40	6.49	6.43	6.51	6.50	6.55
7.02	6.52	7.05	6.48	7.10	6.51	7.00	6.26	7.03	6.29	7.10	6.30
7.20	6.68	7.23	6.66	7.30	6.64	*7.20*	*6.18*	*7.23*	*6.18*	*7.30*	*6.20*
7.40	6.85	7.43	6.84	7.50	6.88	7.40	6.21	7.43	6.21	7.50	6.25
8.00	7.10	8.03	7.09	8.10	7.09	8.00	6.35	8.03	6.33	8.10	6.36
8.20	7.44	8.23	7.43	8.30	7.42	8.20	6.56	8.23	6.59	8.30	6.66
8.40	7.80	8.43	7.77	8.50	7.71	8.40	6.85	8.43	6.84	8.50	6.84
9.00	8.02	9.03	8.09	9.10	8.05	9.00	7.18	9.03	7.17	9.10	7.18
9.20	8.48	9.23	8.41	9.30	8.36	9.20	7.58	9.23	7.54	9.30	7.55
9.40	8.75	9.43	8.81	9.50	8.71	9.40	7.98	9.43	7.94	9.50	7.87
10.00	9.24	10.03	9.20	10.10	9.06	10.00	8.39	10.03	8.37	10.10	8.27
10.20	9.60	10.23	9.58	10.30	9.42	10.20	8.81	10.23	8.74	10.30	8.63
10.40	10.08	10.43	10.01	10.50	9.81	10.40	9.26	10.43	9.20	10.50	9.04
11.00	10.49	11.03	10.43	11.10	10.18	11.00	9.72	11.03	9.65	11.10	9.43
11.20	10.79	11.23	10.73	11.30	10.48	11.20	10.02	11.23	10.02	11.30	9.80
11.40	10.99	11.43	10.90	11.50	10.75	11.40	10.45	11.43	10.39	11.50	10.15
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	*11.12*	*12.03*	*11.04*	*12.10*	*10.90*	12.00	10.76	12.03	10.68	12.10	10.48
12.20	10.98	12.23	10.93	*12.30*	*10.90*	12.20	10.85	12.23	10.79	12.30	10.67
12.40	10.90	12.43	10.88	12.50	10.87	*12.40*	*10.98*	*12.43*	*10.94*	*12.50*	*10.85*
1.00	10.70	1.03	10.67	1.10	10.65	1.00	10.89	1.03	10.84	1.10	10.82
1.20	10.37	1.23	10.35	1.30	10.39	1.20	10.73	1.23	10.70	1.30	10.71
1.40	10.04	1.43	10.05	1.50	10.10	1.40	10.55	1.43	10.50	1.50	10.53
2.00	9.70	2.03	9.73	2.10	9.80	2.00	10.27	2.03	10.27	2.10	10.32
2.20	9.47	2.23	9.48	2.30	9.55	2.20	10.00	2.23	9.97	2.30	10.02
2.40	9.25	2.43	9.28	2.50	9.31	2.40	9.62	2.43	9.66	2.50	9.75
3.00	9.01	3.03	9.02	3.10	9.05	3.00	9.46	3.03	9.45	3.10	9.52
3.20	8.82	3.23	8.88	3.30	8.85	3.20	9.22	3.23	9.28	3.30	9.31
3.40	8.64	3.43	8.63	3.50	8.61	3.40	9.05	3.43	9.11	3.50	9.07
4.00	8.44	4.03	8.42	4.10	8.42	4.00	8.86	4.03	8.90	4.10	8.87
4.20	8.20	4.23	8.18	4.30	8.13	4.20	8.67	4.23	8.69	4.30	8.79
4.40	7.82	4.43	7.85	4.50	7.87	4.40	8.49	4.43	8.47	4.50	8.45
5.00	7.55	5.03	7.56	5.10	7.55	5.00	8.18	5.03	8.18	5.10	8.17
5.20	7.18	5.23	7.22	5.30	7.20	5.20	7.85	5.23	7.88	5.30	7.88
5.40	6.89	5.43	6.93	5.50	6.93	5.40	7.48	5.43	7.52	5.50	7.52
6.00	6.61	6.03	6.62	6.10	6.60	6.00	7.16	6.03	7.20	6.10	7.23
6.20	6.35	6.23	6.35	6.30	6.38	6.20	6.85	6.23	6.87	6.30	6.91
6.40	6.21	6.43	6.21	6.50	6.20	6.40	6.57	6.43	6.60	6.50	6.62
7.00	*6.16*	*7.03*	*6.14*	*7.10*	*6.18*	*7.57	*6.25*	*8.02	*6.25*	*8.08	*6.28*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 11.						*Thursday, September 12.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No 3.	
TIME.	READING.	TIME.	READING	TIME.	READING.	TIME	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*1.32	*10.98*	*1.44	*10.88*	*1.50	*10.82*	*2.00	*10.89*	*2.15	*10.75*	*2.21	*10.70*
5.20	8.21	5.23	8.23	5.30	8.27	5.20	......	5.23	......	5.30	8.35
5.40	7.84	5.43	7.89	5.50	7.93	5.40	7.98	5.43	8.00	5.50	8.07
6.00	7.44	6.03	7 51	6.10	7.57	6 00	7.55	6.03	7.63	6.10	7.68
6.20	7.13	6.23	7.19	6.30	7.23	6.20	7.25	6 23	7.30	6.30	7.37
6.40	6.84	6.43	6.87	6.50	6.91	6.40	6.99	6.43	7.04	6.50	7.06
7.00	6.57	7.03	6.59	7.10	6.62	7.00	6.75	7.03	6.80	7.10	6.76
7.20	6.37	7.23	6.38	7.30	6.40	7.20	6.44	7.23	6.44	7.30	6.48
7.40	*6.23*	7.43	6.23	7.50	6.23	7.40	6.25	7.43	6.26	7.50	6.28
8.00	6.29	*8.03*	*6.19*	*8.10*	*6.22*	8.00	6.14	8.03	6.11	8.10	6.10
8.20	6.16	8.23	6.33	8.30	6.31	8.20	5.92	8.23	5.94	8.30	5.95
8.40	6.49	8.43	6.50	8.50	......	*8.40*	*5.86*	*8.43*	*5.85*	*8.50*	*5.89*
9.00	6.75	9.03	6.74	9.10	6.76	9.00	5.96	9.03	5.95	9.10	6.00
9.20	6.87	9.23	6.91	9.30	6.93	9.20	6.19	9.23	6.14	9.30	6.17
9.40	7.16	9.43	7.13	9.50	7.23	9.40	6.30	9.43	6.29	9.50	6.33
10.00	7.53	10.03	7.51	10.10	7.50	10.00	6.45	10.03	6.45	10.10	6.51
10.20	7.99	10.23	7.91	10.30	7.85	10.20	6.75	10.23	6.76	10.30	6.76
10.40	8.44	10.43	8.38	10.50	8.26	10.40	7.13	10.43	7.16	10.50	7.10
11.00	8.87	11.03	8.85	11.10	8.64	11.00	7.55	11.03	7.53	11.10	7.46
11.20	9.31	11.23	9.28	11.30	9.04	11.20	8.05	11.23	7.98	11.30	7.86
11 40	9.78	11.43	9.70	11.50	9.45	11.40	8.51	11.43	8.45	11.50	8.27
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.23	12.03	10.14	12.10	9.83	12.00	8.95	12.03	8.88	12.10	8.65
12.20	10.51	12.23	10.43	12.30	10.17	12 20	9.36	12.23	9.30	12.30	9.06
12.40	10.83	12.43	10.74	12.50	10.53	12.40	9.79	12.43	9.70	12.50	8.44
1.00	11.02	1.03	10.96	1.10	10.80	1.00	10.12	1.03	10.07	1.10	9.84
1.20	11.18	1.23	11.13	1.30	11.01	1.20	10.45	1.23	10.39	1.30	10.27
1.40	*11.23*	*1.43*	*11.18*	*1.50*	*11.10*	1.40	10.71	1.43	10.61	1.50	10.42
2.00	11.14	2.03	11.09	2.10	11.07	*2.00*	*10.83*	*2.03*	*10.74*	*2.10*	*10.57*
2.20	10.95	2.23	10.90	2.30	10.85	2.20	10.78	2.23	10.69	*2.30*	*10.57*
2.40	10.57	2.43	10.55	2.50	10.59	2.40	10.44	2.43	10.39	2.50	10.36
3.00	10.23	3.03	10.23	3.10	10.31	3.00	10.16	3.03	10.11	3.10	10.14
3.20	9.88	3.23	9.93	3.30	10.01	3.20	9.88	3.23	9.85	3.30	9.83
3.40	9.58	3.43	9.62	3.50	9.71	3 40	9.61	3.43	9.64	3.50	9.72
4.00	9.36	4.03	9.40	4.10	9.50	4.00	9.38	4.03	9.41	4.10	9 45
4.20	9.29	4.23	9.30	4.30	9.33	4.20	9.19	4.23	9.23	4.30	9.24
4.40	9.11	4.43	9.13	4.50	9.13	4.40	9.08	4.43	9.05	4.50	9.09
5.00	8.84	5.03	8.81	5.10	8.82	5.00	8.98	5.03	8.97	5.10	8.97
5.20	8.44	5.23	8.46	5.30	8.50	5.20	8.81	5.23	8.76	5.30	8.75
5.40	8.06	5.43	8.13	5.50	8.18	5.40	8.60	5.43	8 55	5.50	8.53
6.00	7.76	6.03	7.81	6.10	7.85	6.00	8.34	6.03	8.33	6.10	8.33
6.20	7.48	6.23	7.51	6.30	7.53	6.20	7.96	6.23	8.03	6.30	8.09
6.40	7.07	6.43	7.19	6.50	7.16	6.40	7.85	6.43	7.83	6.50	7.83
*8.30	*6.18*	*8.35	*6.18*	*8.40	*6.23*	*9.00	*6.37*	*9.05	*6.38*	*9.10	*6.41*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 13.						*Saturday, September 14.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*2.20	11.03	*2.34	10.90	*2.41	10.82	*3.15	11.04	*3.30	10.90	*3.36	10.86
5.20	......	5.23	......	5.30	......	5.20	9.23	5.23	9.28	5.30	9.36
5.40	8.20	5.43	8.22	5.50	8.25	5.40	9.00	5.43	9.03	5.50	9.11
6.00	8.12	6.03	8.10	6.10	8.05	6.00	8.73	6.03	8.72	6.10	8.80
6.20	7.69	6.23	7.70	6.30	7.71	6.20	8.38	6.23	8.39	6.30	8.45
6.40	7.49	6.43	7.51	6.50	7.56	6.40	8.19	6.43	8.21	6.50	8.24
7.00	7.32	7.03	7.31	7.10	7.31	7.00	7.89	7.03	7.90	7.10	7.90
7.20	7.05	7.23	7.08	7.30	7.09	7.20	7.57	7.23	7.61	7.30	7.60
7.40	6.85	7.43	6.89	7.50	6.85	7.40	7.35	7.43	7.39	7.50	7.40
8.00	6.63	8.03	6.61	8.10	6.60	8.00	7.09	8.03	7.10	8.10	7.10
8.20	6.36	8.23	6.36	8.30	6.39	8.20	6.88	8.23	6.89	8.30	6.87
8.40	6.20	8.43	6.21	8.50	6.18	8.40	6.65	8.43	6.65	8.50	6.66
9.00	5.95	9.03	5.98	9.10	5.99	9.00	6.59	9.03	6.57	9.10	6.58
9.20	5.88	9.23	5.88	9.30	5.89	9.20	6.45	*9.23*	*6.39*	*9.30*	*6.41*
9.40	*5.81*	*9.43*	*5.83*	*9.50*	*5.82*	*9.40*	*6.41*	9.51	6.42	9.55	6.45
10.00	5.90	10.03	5.91	10.10	5.89	10.00	6.49	10.03	6.45	10.10	6.46
10.20	6.05	10.23	6.06	10.30	6.01	10.20	6.56	10.23	6.54	10.30	6.62
10.40	6.35	10.43	6.39	10.50	6.39	10.40	6.80	10.43	6.80	10.50	6.81
11.00	6.79	11.03	......	11.10	6.69	11.00	7.08	11.03	7.10	11.10	7.07
11.20	7.21	11.23	7.18	11.30	7.09	11.20	7.37	11.23	7.38	11.30	7.39
11.40	7.71	11.43	7.68	11.50	7.55	11.40	7.85	11.43	7.82	11.50	7.76
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	8.06	12.03	7.98	12.10	7.85	12.00	8.26	12.03	8.21	12.10	8.07
12.20	8.41	12.23	8.58	12.30	8.25	12.20	8.58	12.23	8.55	12.30	8.40
12.40	8.91	12.43	8.85	12.50	8.65	12.40	8.96	12.43	8.89	12.50	8.80
1.00	9.25	1.03	9.21	1.10	9.02	1.00	9.30	1.03	9.25	1.10	9.14
1.20	9.60	1.23	9.55	1.30	9.34	1.20	9.58	1.23	9.54	1.30	9.34
1.40	9.93	1.43	9.87	1.50	9.78	1.40	9.93	1.43	9.90	1.50	9.78
2.00	10.24	2.03	10.16	2.10	10.01	2.00	10.28	2.03	10.26	2.10	10.07
2.20	*10.29*	*2.23*	*10.24*	*2.30*	*10.18*	2.20	10.54	2.23	10.49	2.30	10.40
2.40	10.27	2.43	10.23	2.50	10.16	2.40	10.80	2.43	10.83	2.50	10.59
3.00	10.10	3.03	10.09	3.10	10.10	3.00	10.94	3.03	10.88	3.10	10.78
3.20	10.03	3.23	10.00	3.30	10.01	*3.20*	*10.96*	*3.23*	*10.91*	*3.30*	*10.95*
3.40	9.56	3.43	9.57	3.50	9.63	3.40	10.75	3.43	10.68	3.50	10.71
4.00	9.23	4.03	9.25	4.10	9.33	4.00	10.50	4.03	10.50	4.10	10.52
4.20	8.82	4.23	8.88	4.30	9.00	4.20	10.25	4.23	10.26	4.30	10.32
4.40	8.69	4.43	8.72	4.50	8.78	4.40	10.03	4.43	10.05	4.50	10.14
5.00	8.54	5.03	8.54	5.10	8.53	5.00	9.87	5.03	9.88	5.10	9.93
5.20	8.45	5.23	8.44	5.30	8.46	5.20	9.71	5.23	9.73	5.30	9.78
5.40	8.43	5.43	8.37	5.50	8.35	5.40	9.60	5.43	9.59	5.50	9.62
6.00	8.19	6.03	8.15	6.10	8.13	6.00	9.41	6.03	9.38	6.10	9.37
6.20	7.99	6.23	7.97	6.30	7.95	6.20	9.16	6.23	9.17	6.30	9.16
6.40	7.68	6.43	7.66	6.50	7.64	6.40	8.95	6.43	8.91	6.50	8.94
*9.15	5.92	*9.20	5.92	*9.25	5.96	*10.20	7.18	*10.25	7.18	*10.30	7.21

*Sunday, September 15, A. M.**						*Sunday, September 15, P. M.**					
3.14	*11.25*	*3.33*	*11.12*	*3.40*	*11.09*	*3.35*	*11.20*	*3.48*	*11.09*	*3.54*	*11.05*
10.37	*7.07*	*10.41*	*7.07*	*10.46*	*7.12*	*10.40*	*7.30*	*10.50*	*7.30*	*10.57*	*7.33*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 16.						*Tuesday, September 17.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*4.00	*11.22*	*4.05	*11.19*	*4.10	*11.15*	*4.45	*10.50*	*4.49	*10.48*	*4.55	*10.45*
5.20	9.81	5.23	9.85	5.30	9.98	5 20	10.09	5.23	10.08	5.30	10.14
5.40	9.65	5.43	9.69	5.50	9.82	5.40	9.77	5.43	9.80	5.50	9.86
6.00	9.41	6.03	9.45	6.10	9.59	6.00	9.44	6.03	9.48	6.10	9.55
6.20	9.21	6.23	9.27	6.30	9.36	6.20	9.16	6.23	9.21	6.30	9.28
6.40	9.02	6.43	9.06	6.50	9.12	6.40	8.84	6.43	8.90	6.50	8.97
7.00	8.85	7.03	8.88	7.10	8.94	7.00	8.64	7.03	8.68	7.10	8.75
7.20	8.66	7.23	8.66	7.30	8.68	7.20	8.50	7.23	8.50	7.30	8.53
7.40	8.42	7.43	8.42	7.50	8 46	7.40	8.38	7.43	8.38	7.50	8.40
8.00	8.23	8.03	8.23	8.10	8.24	8.00	8.33	8.03	8.31	8.10	8.30
8.20	8.02	8.23	8.01	8.30	8.03	8.20	8.19	8.23	8.15	8.30	8 13
8.40	7.79	8.43	7.80	8.50	7.80	8.40	8.04	8.43	8.03	8.50	8.03
9.00	7.50	9.03	7.50	9.10	7.53	9.00	7.91	9.03	7.89	9.10	7.86
9.20	7.33	9.23	7.33	9.30	7.36	9.20	7.65	9.23	7.65	9.30	7.67
9.40	7.08	9.43	7.10	9.50	7.09	9.40	7.47	9.43	7.50	9.50	7.47
10.00	6.91	10.03	6.93	10.10	6.93	10.00	7.29	10.03	7.28	10.10	7.27
10.20	6.76	10.23	6.75	10.30	6.73	10.20	7.20	10.23	7.19	10.30	7.19
10.40	*6.63*	*10.43*	*6.61*	10.50	6.64	10.40	7.00	10.43	6.99	10.50	6 99
11.00	6.64	11.03	6.62	*11.10*	*6.63*	11.00	6.85	11.03	6.85	11.10	6.90
11.20	6.67	11.23	6.66	11.30	6.71	11.20	6.80	11.23	6.79	*11.30*	*6.79*
11.40	6.86	11.43	6.84	11.50	6.87	*11.40*	*6.78*	*11.43*	*6.75*	11.50	6.80
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.01	12.03	6.99	12.10	7.07	12.00	6.79	*12.03*	*6.75*	12.10	6.80
12.20	7.31	12.23	7.31	12.30	7.36	12.20	6.84	12.23	6.82	12.30	6.86
12.40	7.62	12.43	7.60	12.50	7.60	12.40	6.90	12.43	6.89	12.50	6.93
1.00	7.88	1.03	7.86	1.10	7.86	1.00	7.03	1.03	6.98	1.10	7.05
1.20	8.15	1.23	8.13	1.30	8.15	1.20	7.29	1.23	7.21	1.30	7.28
1.40	8.51	1.43	8.49	1.50	8.46	1.40	7.55	1.43	7.48	1.50	7.51
2.00	8.89	2.03	8.85	2.10	8.77	2.00	7.89	2.03	7 85	2.10	7.83
2.20	9.35	2.23	9.28	2.30	9.15	2.20	8.20	2.23	8.20	2 30	8.15
2.40	9.74	2.43	9.68	2.50	9.49	2.40	8.67	2.43	8.62	2.50	8.52
3.00	10.07	3.03	10.02	3.10	9.85	3.00	9.01	3.03	8.96	3.10	8.86
3.20	10.29	3.23	10.24	3.30	10.08	3.20	9.36	3.23	9.31	3.30	.....
3.40	10.54	3.43	10.50	3.50	10.34	3.40	9.75	3.43	9.69	3.50	9.53
4.00	*10.61*	*4.03*	*10.57*	*4.10*	*10.44*	4.00	10.10	4.03	10.08	4.10	.....
4.20	10.45	4.23	10.39	4.30	10.35	*4.20*	*10.31*	*4.23*	*10.29*	4.30	.....
4.40	10.26	4.43	10.21	4.50	10.26	4.40	10.30	4.43	10.27	4.50	10.24
5.00	10.07	5.03	10.04	5.10	10.09	5.00	10.28	5.03	10.24	5.10	.....
5.20	9.83	5.23	9.82	5.30	9.88	5.20	10.14	5.23	10.12	5.30	10.10
5.40	9.63	5.43	9.62	5.50	9.68	5.40	9.99	5.43	9.97	5.50	9.92
6.00	9.39	6.03	9.39	6.10	9.43	6.00	......	6.03	......	6.10	.....
6.20	9.25	6.23	9.23	6.30	9.27	6.20	......	6.23	......	6.30	.....
6.40	......	6.43	.....	6.35	9.20	6.40	......	6.43	......	6.50	.....
*11.20	*6.97*	*11.25	*6.98*	*11.31	*7.01*						

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 18.						*Thursday, September 19.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*_0.10_	_7.17_	*_0.16_	_7.19_	*_0.23_	_7.20_	*_0.50_	_7.24_	*_0.55_	_7.26_	*_1.01_	_7.29_
_5.20_	_10.48_	_5.23_	_10.43_	_5.30_	_10.44_	5.20	......	5.23	......	5.30	10.27
5.40	10.35	5.43	10.33	5.50	10.35	_5.40_	_10.34_	_5.43_	_10.29_	_5.50_	_10.30_
6.00	10.19	6.03	10.18	6.10	10.22	6.00	10.29	6.03	10.24	_6.10_	_10.30_
6.20	9.95	6.23	9.96	6.30	9.99	6.20	10.27	6.23	10.24	6.30	10.29
6.40	9.67	6.43	9.70	6.50	9.75	6.40	10.26	6.47	10.24	6.50	10.27
7.00	9.43	7.03	9.45	7.10	9.49	7.00	10.16	7.03	10 10	7.10	10.12
7.20	9.19	7.23	9.19	7.30	9.23	7.20	9.90	7.23	9.87	7.30	9.90
7.40	8.96	7.43	8.99	7.50	9.03	7.40	9.69	7.43	9.68	7.50	9 70
8.00	8.82	8.03	8.83	8.10	8.82	8.00	9.44	8.03	9.41	8.10	9.45
8.20	8.61	8.23	8.60	8.30	8.58	8.20	9.15	8.23	9.15	8.30	9.19
8.40	8.43	8.43	8.43	8.50	8.42	8.40	8.90	8.43	8.91	8.50	8.94
9.00	8.26	9.03	8.24	9.10	8.25	9.00	8.74	9.03	8.75	9.10	8.75
9.20	8.17	9.23	8.15	9.30	8.14	9.20	8.56	9.23	8.55	9.30	8.55
9.40	8.07	9.43	8.05	9.50	8.00	9.40	8.42	9.43	8.44	9.50	8.43
10.00	7.90	10.03	7.87	10.10	7.90	10.00	8.30	10.03	8.32	10.10	8.31
10.20	7.82	10.23	7.80	10.30	7.80	10.20	8.26	10.23	8.24	10.30	8.28
10.40	7.69	10.43	7.65	10.50	7.64	10.40	8.21	10.43	8.19	10.50	8.18
11.00	7.64	11.03	7.61	11.10	7.59	11.00	8.14	11.03	8.11	11.10	8.11
11.20	7.49	11.23	7.45	11.30	7.47	11.20	7.98	11.23	7.94	11.30	7.93
11.40	7.41	11.43	7.41	11.50	7.45	11.40	7.73	11.43	7.73	11.50	7.74
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.40	12.03	7.36	12.10	7.37	12.00	7.48	12.03	7.49	12.10	7.53
12.20	7.32	12.23	7.30	12.30	7.33	12.20	7.32	12.23	7.35	12.30	7.39
12.40	7.26	12.43	7.25	12.50	7.27	12.40	7.24	12.43	7.22	12.50	7.22
_1.00_	_7.22_	_1.03_	_7.21_	_1.10_	_7.25_	1.00	7.02	1.03	7.01	1.10	7.03
1.20	7.26	1.23	7.23	1.30	7.28	1.20	6.94	1.23	6.93	1.30	6.97
1.40	7.34	1.43	7.31	1.50	7.34	_1.40_	_6.85_	_1.43_	_6.84_	_1.50_	_6.88_
2.00	7.53	2.03	7.51	2.10	7.54	2.00	6.97	2.03	6.95	2.10	6.99
2.20	7.74	2.23	7.70	2.30	7.73	2.20	7.11	2.23	7.09	2.30	7.12
2.40	8.00	2.43	8.01	2.50	8.02	2.40	7.35	2.43	7.33	2.50	7.35
3.00	8.42	3.03	8.38	3.10	8.31	3.00	7.57	3.03	7.53	3.10	7.56
3.20	8.70	3.23	8.66	3.30	8.57	3.20	7.82	3.23	7.77	3.30	7.80
3.40	9.05	3.43	9.01	3.50	8.91	3.40	8.09	3.43	8.06	3.50	8.06
4.00	9.37	4.03	9.34	4.10	9.20	4.00	8.39	4.03	8.35	4.10	8.32
4.20	9.69	4.23	9.67	4.30	9.52	4.20	8.69	4.23	8.64	4.30	8.60
4.40	10.04	4.43	9.99	4.50	9.85	4.40	9.14	4.43	9.08	4.50	8.95
5.00	10.20	5.03	10.16	5.10	10.02	5.00	9.41	5.03	9.37	5.10	9.23
5.20	10.23	_5.23_	_10.24_	5.30	10.18	5.20	9.63	5.23	9.59	5.30	9.48
_5.40_	_10.27_	5.43	10 22	_5.50_	_10 20_	_5 40_	_9.78_	_5.43_	_9.73_	_5.50_	_9.66_
6.00	10.13	6.03	10.08	6.10	10.10	6.00	9.71	6.03	9.64	_6.10_	_9.66_
6.20	9.93	6.23	9.89	6.30	9.91	6.20	9.65	6.23	9.61	_6.30_	_9.66_
6.40	9.66	6.43	9.65	6.50	9.72	6.40	9.60	6.43	9.61	6.50	9.62

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 20.						*Saturday, September 21.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
_*1.50_	_6.97_	_*1.54_	_6.97_	_*2.00_	_7.03_	_*3.00_	_6.84_	_*3.05_	_6.84_	_*3.12_	_6.90_
5.20	9.55	5.23	9.50	5.30	9.46	5.20	8.68	5.23	8.66	5.30	8.63
5.40	9.76	5.43	9.72	5.50	9.68	5.40	8.99	5.43	8.98	5.50	8.92
6.00	9.88	6.03	9.83	6.10	9.83	6.00	9.25	6.03	9.22	6.10	9.18
_6.20_	_9.96_	_6.23_	_9.92_	6.30	9.94	6.20	9.52	6.23	9.49	6.30	9.43
6.40	9.95	6.43	9.90	_6.50_	_9.95_	6.40	9.70	6.43	9.67	6.50	9.62
7.00	9.92	7.03	9.89	7.10	9.93	7.00	9.80	7.03	9.76	7.10	9.78
7.20	9.90	7.23	9.89	7.30	9.92	7.20	9.90	7.23	9.88	7.30	9.90
7.40	9.82	7.43	9.80	7.50	9.80	7.40	10.00	_7.43_	_9.96_	_7.50_	_9.99_
8.00	9.66	8.03	9.61	8.10	9.62	_8.00_	_10.02_	_8.03_	_9.96_	8.10	9.98
8.20	9.43	8.23	9.42	8.30	9.45	8.20	9.91	7.23	9.85	8.30	9.89
8.40	9.20	8.43	9.20	8.50	9.24	8.40	9.80	8.43	9.75	8.50	9.79
9.00	9.05	9.03	9.03	9.10	9.06	9.00	9.66	9.03	9.64	9.10	9.68
9.20	8.88	9.23	8.88	9.30	8.90	9.20	9.55	9.23	9.54	9.30	9.55
9.40	8.82	9.43	8.79	9.50	8.80	9.40	9.35	9.43	9.31	9.50	9.31
10.00	8.73	10.03	8.69	10.10	8.72	10.00	9.13	10.03	9.13	10.10	9.17
10.20	8.62	10.23	8.59	10.30	8.57	10.20	9.04	10.23	9.02	10.30	9.01
10.40	8.48	10.43	8.47	10.50	8.46	10.40	8.91	10.43	8.84	10.50	8.87
11.00	8.36	11.03	8.35	11.10	8.36	11.00	8.84	11.03	8.81	11.10	8.82
11.20	8.17	11.23	8.19	11.30	8.20	11.20	8.75	11.23	8.70	11.30	8.71
11.40	8.16	11.43	8.14	11.50	8.11	11.40	8.65	11.43	8.62	11.50	8.64
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.94	12.03	7.91	12.10	7.89	12.00	8.50	12.03	8.47	12.10	8.48
12.20	7.70	12.23	7.72	12.30	7.75	12.20	8.35	12.23	8.34	12.30	8.37
12.40	7.47	12.43	7.47	12.50	7.48	12.40	8.21	12.43	8.21	12.50	8.23
1.00	7.19	1,03	7.20	1.10	7.23	1.00	7.98	1.03	7.98	1.10	7.99
1.20	6.95	1.23	6.99	1.30	7.01	1.20	7.72	1.23	7.73	1.30	7.74
1.40	6.81	1.43	6.82	1.50	6.83	1.40	7.41	1.43	7.43	1.50	7.46
_2.00_	_6.77_	_2.03_	_6.72_	_2.10_	_6.75_	2.00	7.20	2.03	7.21	2.10	7.25
2.20	6.78	2.23	6.74	2.30	6.77	2.20	7.14	2.23	7.15	2.30	7.15
2.40	6.84	2.43	6.81	2.50	6.83	2.40	6.96	2.43	6.94	2.50	6.97
3.00	6.94	3.03	6.90	3.10	6.92	3.00	6.88	3.03	6.85	3.10	6.87
3.20	7.10	3.23	7.09	3.30	7.13	_3.20_	_6.78_	_3.23_	_6.76_	_3.30_	_6.77_
3.40	7.27	3.43	7.24	3.50	7.27	_3.40_	_6.78_	3.43	6.78	3.50	6.81
4.00	7.56	4.03	7.56	4.10	7.57	4.00	6.83	4.03	6.80	4.10	6.86
4.20	7.86	4.23	7.80	4.30	7.81	4.20	6.93	4.23	6.90	4.30	6,95
4.40	8.16	4.43	8.14	4.50	8.13	4.40	7.15	4.43	7.13	4.50	7.16
5.00	8.43	5.03	8.39	5.10	8.35	5.00	7.37	5.03	7.36	5.10	7.37
5.20	8.72	5.23	8.67	5.30	8.62	5.20	7.69	5.23	7.67	5.30	7.67
5.40	8.95	5.43	8.94	5.50	8.87	5.40	7.97	5.43	7.93	5.50	7.91
6.00	9.12	6.03	9.11	6.10	9.07	6.00	8.19	6.03	8.18	6.10	8.17
6.20	9.29	6.23	9.25	6.30	9.23	6.20	8.53	6.23	8.51	6.30	8.48
6.40	9.37	6.43	9.32	6.50	9.31	6.40	8.85	6.43	8.85	6.50	8.80
_*8.11_	_9.45_	_*8.17_	_9.43_	_*8.25_	_9.39_	_*8.55_	_10.17_	_*9.02_	_10.15_	_*9.10_	_10.11_

*Sunday, September 22, A. M.**						*Sunday, September 22, P. M.**					
_4.00_	_7.22_	_4.06_	_7.23_	_4.14_	_7.27_	_4.20_	_6.43_	_4.25_	_6.44_	_4.30_	_6.48_
_10.02_	_10.50_	_10.09_	_10.45_	_10.14_	_10.43_	_11.08_	_10.68_	_11.12_	_10.65_	_11.20_	_10.65_

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 23.						*Tuesday, September 24.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
Time.	Reading.	Time.	Read'g.	Time.	Read'g.	Time.	Reading	Time.	Reading.	Time.	Read'g.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**5.05*	*6.50*	**5.10*	*6.51*	**5.16*	*6.53*						
5.20	6.55	5.23	6.54	5.30	6.60	5 20	......	5.23	......	5.30	6.21
5.40	6.80	5.43	6.80	5.50	6.83	*5.40*	*6.02*	*5.43*	*6.02*	*5.50*	*6.04*
6.00	7.21	6.03	7.17	6.10	7.17	6.00	6.06	*6.03*	*6.02*	6.10	6.06
6.20	7.63	6.23	7.57	6.30	7.52	6.20	6.19	6.23	6.18	6.30	6.22
6.40	8.10	6.43	8.02	6.50	7.93	6.40	6.51	6.43	6.48	6.50	6.50
7.00	8.45	7.03	8.38	7.10	8.27	7.00	6.84	7.03	6.80	7.10	6.81
7.20	8.80	7.23	8.75	7.30	8 64	7.20	7.27	7.23	7.23	7.30	7.18
7.40	9.16	7.43	9.09	7.50	8.99	7.40	7.59	7.43	7.54	7.50	7.56
8.00	9.51	8.03	9.45	8.10	9.35	8.00	8.05	8.03	8.00	8.10	7.91
8.20	9.88	8.23	9.80	8.30	9.70	8.20	8.48	8.23	8.40	8.30	8 26
8.40	10.10	8.43	10.05	8.50	9.92	8.40	8.88	8.43	8.82	8.50	8.64
9.00	10.38	9.03	10.34	9.10	10.23	9.00	9.30	9.03	9.20	9.10	9.00
9.20	10.62	9.23	10.56	9.30	10.48	9.20	9.58	9.23	9.50	9.30	9.37
9.40	10.81	9.43	10.76	9.50	10.71	9.40	10.00	9.43	9.94	9.50	9.74
10.00	11.01	10.03	10.97	10.10	10.90	10.00	10.32	10.03	10.22	10.10	10.10
10.20	*11.07*	*10.23*	*11.02*	10.30	10.97	10.20	10.67	10.23	10.58	10.30	10 40
10.40	11.00	10.43	10.97	*10.50*	*10.98*	10.40	10.94	10.43	10.87	10.50	10.66
11.00	10.95	11.03	10.98	11.10	10.93	11.00	11.14	11.03	11.10	11.10	10.95
11.20	10.74	11.23	10.71	11.30	10.75	11.20	11.42	11.23	11.36	11.30	11.22
11.40	10.48	11.43	10.45	11.50	10.52	*11.40*	*11.47*	*11.43*	*11.42*	*11.50*	*11.30*
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.12	12.03	10.18	12.10	10.26	12.00	11.23	12.03	11.15	12.10	11.12
12.20	9.96	12.23	9.99	12.30	10.05	12.20	10.86	12.23	10.84	12.30	10.88
12.40	9.81	12.43	9.84	12.50	9.89	12.40	10.52	12.43	10.52	12.50	10.62
1.00	9.70	1.03	9.68	1.10	9.71	1.00	10.31	1.03	10.31	1.10	10.41
1.20	9.49	1.23	9.49	1.30	9.49	1.20	10.10	1.23	10.09	1.30	10.13
1.40	9.29	1.43	9.26	1.50	9.29	1.40	9.81	1.43	9.77	1.50	9.85
2.00	9.07	2.03	9.05	2.10	9.05	2.00	9.59	2.03	9.57	2.10	9.64
2.20	8.85	2.23	8.80	2.30	8.80	2.20	9.29	2.23	9.29	2 30	9.37
2.40	8.47	2.43	8.47	2.50	8.49	2.40	9.05	2.43	9.05	2.50	9.10
3.00	8.17	3.03	8.17	3.10	8.20	3.00	8.75	3.03	8.76	3.10	8.76
3.20	7.82	3.23	7.82	3.30	7.86	3.20	8.32	3.23	8.33	3.30	8.36
3.40	7.46	3.43	7.49	3.50	7.50	3.40	7.95	3.43	7.99	3.50	8.05
4.00	7.08	4.03	7.15	4.10	7.17	4.00	7.41	4.03	7.43	4.10	7.62
4.20	6.65	4.23	6.59	4.30	6.72	4.20	6.88	4.23	6.92	4.30	7.10
4.40	6.33	4.43	6.39	4.50	6.44	4.40	6.50	4.43	6.58	4.50	6.75
5.00	6.18	5.03	6.20	5.10	6.21	5.00	6.15	5.03	6.25	5.10	6.25
5.20	6.14	5 23	6.11	5.30	6.12	5.20	5.75	5.23	5.80	5.30	5.87
5.40	*6.13*	*5.43*	*6.10*	*5.50*	*6.11*	5.40	5.53	5.43	5.54	5.50	5.58
6.00	6.19	6.03	6.19	6.10	6 26	6.00	5.50	6.03	5.49	*6.10*	*5.47*
6.20	6.45	6.23	6.48	6.30	6.54	*6.25*	*5.48*	*6.28*	*5.48*	*6.40*	*5.47*
6.40	......	6.43	.....	6.50	.....						
**11.33*	*10.94*	**11.38*	*10.94*	**11.45*	*10.89*						

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 25.						*Thursday, September 26.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*0.00	*11.17*	*0.04	*11.14*	*0.10	*11.10*	*0.39	*11.65*	*0.43	*11.63*	*0.50	*11.53*
5.20	6.21	5.23	6.39	5.30	6.53	5.20	......	5.23	......	5.30	7.45
5.40	5.80	5.43	5.97	5.50	6.10	5.40	6.46	5.43	6.68	5.50	6.94
6.00	5.56	6.03	5.65	6.10	5.72	6.00	5.83	6.03	6.10	6.10	6.34
6.20	5.44	6.23	5.48	6.30	5.50	6.20	5.29	6.23	5.55	6.30	5.75
6.40	*5.36*	*6.43*	*5.35*	*6.50*	*5.39*	6.40	4.86	6.43	5.07	6.50	5.24
7.00	5.50	7.03	5.49	7.10	5.51	7.00	4.56	7.03	4.70	7.10	4.80
7.20	5.75	7.23	5.72	7.30	5.73	*7.20*	*4.50*	7.23	4 54	7.30	4.58
7.40	6.15	7.43	6.12	7.50	6.11	7.40	4.57	*7.43*	*4.50*	*7.50*	*4 55*
8.00	6.60	8.03	6.55	8.10	6.47	8.00	4.72	8.03	4.70	8.10	4.71
8.20	7.00	8.23	6.94	8.30	6.86	8.20	5.10	8.23	5.07	8.30	5.10
8.40	7.44	8.43	7.36	8.50	7.25	8.40	5.50	8.43	5.44	8.50	5.41
9.00	7.92	9.03	7.84	9.10	7.70	9.00	5.95	9.03	5.89	9.10	5.82
9.20	8.37	9.23	8.30	9.30	8.12	9.20	6.40	9.23	6.35	9.30	6.26
9.40	8.87	9.43	8.81	9.50	8.58	9.40	6.82	9.43	6.77	9.50	6.70
10.00	9.45	10.03	9.32	10.10	9.04	10.00	......	10.03	......	10.10	7.24
10.20	9.94	10.23	9.84	10.30	9.50	10.20	8.20	10.23	8.08	10.30	.....
10.40	10.43	10.43	10.32	10.50	9.94	10.40	8.75	10.43	8.61	10.50	8.38
11.00	10.97	11.03	10.80	11.10	10.42	11.00	9.35	11.03	9.25	11.10	8.82
11.20	11.32	11.23	11.15	11.30	10.79	11.20	9.87	11.23	9.70	11.30	9.30
11.40	11.58	11.43	11.50	11.50	11.17	11.40	10.33	11.43	10.25	11.50	9.76
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	11.88	12.03	11.80	12.10	11.49	12.00	......	12.03	......	12.10	.....
12.20	*11.97*	*12.23*	*11.89*	12.30	11.71	12.20	11.13	12.23	11.05	12.30	10.60
12.40	11.87	12.43	11.80	*12.50*	*11.72*	12.40	11.37	12.43	11.28	12.50	10.95
1.00	11.60	1.03	11.55	1.10	11.52	*1.00*	*11.53*	*1.03*	*11.43*	1.10	11.19
1.20	11.26	1.23	11.22	1.30	11.28	1.20	11.41	1.23	11.32	*1.30*	*11.20*
1.40	10.95	1.43	10.91	1.50	10.98	1.40	11.05	1.43	11.10	1.50	11.05
2.00	10.63	2.03	10.62	2.10	10.72	2.00	10.74	2.03	10.72	2.10	10.77
2.20	10.35	2.23	10.36	2.30	10.39	2.20	10.32	2.23	10.30	2.30	10.53
2.40	10.09	2.43	10.10	2.50	10.15	2.40	10.17	2.43	10.18	2.50	10.30
3.00	9.85	3.03	9.86	3.10	10.10	3.00	10.12	3.03	10.14	3.10	10.18
3.20	9.62	3.23	9.63	3.30	9.74	3.20	10.01	3.23	10.02	3.30	10.09
3.40	9.21	3.43	9.25	3.50	9.32	3.40	9.90	3.43	9.87	3.50	9.90
4.00	8.79	4.03	8.84	4.10	8.90	4.00	9.70	4.03	9.70	4.10	9.68
4.20	8.34	4.23	8.41	4.30	8.48	4.20	9.41	4.23	9.39	4.30	9.37
4.40	7.85	4.43	7.93	4.50	8.04	4.40	9.00	4.43	9.00	4.50	8.95
5.00	7.32	5.03	7.42	5.10	7.59	5.00	8.57	5.03	8.60	5.10	8.63
5.20	6.71	5.23	6.81	5.30	6.97	5.20	8.08	5.23	8.11	5.30	8.25
5.40	6.25	5.43	6.35	5.50	6.49	5.40	7.45	5.43	7.49	5.50	7.60
6.00	5.75	6.03	5.85	6.10	5.99	6.00	6.85	6.03	7.00	6.10	7.20
6.20	5.42	6.23	5.60	6.30	5.65	*8.06	*5.00*	*8.11	*5.01*	*8.20	*5.05*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 27.						Saturday, September 28.					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*1.40	12.40	*1.50	12.25	*1 55	12.15						
5.40	8.85	5.43	9.06	5.50	9.00	*2.25	12.56	*2.31	12.52	*2.37	12.36
6.00	8.25	6.03	8.41	6.10	8.50						
6.20	7.49	6.23	7.67	6.30	7.92						
6.40	6.81	6.43	7.03	6.50	7.31						
7.00	6.25	7.03	6.35	7.10	6.63						
7.20	5.84	7.23	6.00	7.30	6.17						
7.40	5.47	7.43	5.65	7.50	5.75						
8.00	5.17	8.03	5.30	8.10	5.35	8.00	6.05	8.03	6.21	8.10	6.40
8.20	5.17	8.23	5.18	8.30	5.19	8.20	5.59	8.23	5.70	8.30	5.85
8.40	5.21	8.43	5.17	8.50	5.17	8.40	5.20	8.43	5.35	8.50	5.44
9.00	5.44	9.03	5.42	9.10	5.40	9.00	5.01	9.03	5.07	9.10	5.10
9.20	5.86	9.23	5.86	9.30	5.77	9.20	5.02	9.23	5.01	9.30	4.99
9.40	6.41	9.43	6.32	9.50	6.22	9.40	5.01	9.43	5.01	9.50	5.00
10.00	6.88	10.03	6.80	10.10	6.66	10.00	5.21	10.03	5.21	10.10	5.20
10.20	7.36	10.23	7.28	10.30	7.03	10.20	5.49	10.23	5.51	10.30	5.55
10.40	7.91	10.43	7.81	10.50	7.60	10.40	5.94	10.43	5.94	10.50	5.93
11.00	8.41	11.03	8.36	11.10	8.03	11.00	6.59	11.03	6.58	11.10	6.43
11.20	8.97	11.23	8.85	11.30	8.60	11.20	7.12	11.23	7.00	11.30	6.85
11.40	9.64	11.43	9.52	11.50	9.14	11.40	7.75	11.43	7.65	11.50	7.40
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.26	12.03	10.16	12.10	9.66	12.00	8.41	12.03	8.30	12.10	7.92
12.20	10.75	12.23	10.58	12.30	10.10	12.20	9.04	12.23	8.80	12.30	8.52
12.40	11.29	12.43	11.15	12.50	10.55	12.40	9.67	12.43	9.47	12.50	9.01
1.00	11.64	1.03	11.50	1.10	11.00	1.00	10.26	1.03	10.10	1.10	9.59
1.20	11.90	1.23	11.80	1.30	11.36	1.20	10.78	1.23	10.58	1.30	10.09
1.40	12.01	1.43	11.89	1.50	11.60	1.40	11.30	1.43	11.07	1.50	10.59
2.00	11.98	2.03	11.90	2.10	11.73	2.00	11.65	2.03	11.53	2.10	10.99
2.20	11.75	2.23	11.65	2.30	11.58	2.20	11.89	2.23	11.72	2.30	11.34
2.40	11.24	2.43	11.22	2.50	11.23	2.40	11.89	2.43	11.80	2.50	11.52
3.00	10.96	3.03	......	3.10	......	3.00	11.76	3.03	11.67	3.10	11.55
3.20	10.80	3.23	10.80	3.30	10.89	3.20	11.41	3.23	11.36	3.30	11.32
3.40	10.86	3.43	10.83	3.50	10.87	3.40	11.15	3.43	11.16	3.50	11.19
4.00	10.90	4.03	10.85	4.10	10.88	4.00	11.03	4.03	11.01	4.10	11.06
4.20	10.90	4.23	10.89	4.30	10.87	4.20	10.95	4.23	10.94	4.30	10.98
4.40	10.84	4.43	10.79	4.50	10.77	4.40	10.96	4.43	10.93	4.50	10.94
5.00	10.59	5.03	10.55	5.10	10.57	5.00	10.94	5.03	10.91	5.10	10.93
5.20	10.21	5.23	10.20	5.30	10.22	5.20	10.91	5.23	10.87	5.30	10.85
5.40	......	5.43	......	5.50	......	5.40	10.70	5.43	10.66	5.50	10.67
6.00	......	6.03	......	6.10	......	6.00	10.24	6.03	10.25	6.10	10.28
6.20	......	6.23	......	6.30	......	6.20	9.82	6.23	9.85	6.30	9.97
*8.45	5.31	*8.49	5.32	*8.55	5.37	*9.40	5.75	*9.44	5.77	*9.49	5.81

Sunday, September 29, A. M.*						Sunday, September 29, P. M.*					
3.14	12.46	3.20	12.40	3.27	12.23	4.03	11.25	4.10	11.18	4.15	11.14
10.13	5.00	10.16	5.00	10.20	5.03	10.27	6.09	10.33	6.09	10.40	6.10

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 30.						*Tuesday, October 1.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING.
A. M.										A. M.	
		A. M.		A. M.		A. M.		A. M.		_*0.03_	_6.09_
_*3.48_	_11.85_	_*3.52_	_11.82_	_*4.00_	_11.75_	_*4.44_	_11.40_	_*4.49_	_11.37_	_*4.56_	_11.27_
5.40	9.76	5.43	9.82	5.50	10.08	5.40	10.38	5.43	10.42	5.50	10.57
6.00	9.62	6.03	9.66	6.10	9.78	6.00	10.09	6.03	10.12	6.10	10.27
6.20	9.51	6.23	9.53	6 30	9.62	6.20	9.80	6.23	9.84	6.30	9.95
6.40	9.41	6.43	9.42	6.50	9 46	6.40	9.56	6.43	9.62	6.50	9.73
7.00	9.33	7.03	9.35	7.10	9.31	7.00	9.39	7.03	9.43	7.10	9.57
7.20	9.08	7.23	9.10	7.30	9.16	7.20	9.23	7.23	9.24	7.30	9.30
7.40	8.84	7.43	8.83	7.50	8.85	7.40	9.11	7.43	9.10	7.50	9.14
8.00	8.46	8.03	8.52	8.10	8.58	8.00	9.06	8.03	9.01	8.10	9.01
8.20	8.14	8.23	8.19	8.30	8.26	8.20	8.74	8.23	8.73	8.30	8.74
8.40	7.58	8.43	7.66	8.50	7.77	8.40	8.55	8.43	8 54	8.50	8.53
9.00	7.13	9.03	7.23	9.10	7.36	9.00	8.09	9.03	8.12	9.10	8.16
9.20	6.66	9.23	6.77	9.30	6.88	9.20	7.80	9.23	7.87	9.30	7.92
9.40	6.16	9.43	6.27	9.50	6.35	9.40	7.50	9.43	7.50	9.50	7.53
10 00	5.55	10.03	5.78	10.10	5.88	10.00	7.13	10.03	7.18	10.10	7.20
10.20	5.36	10.23	5.41	10.30	5.50	10.20	6.78	10.23	6.80	10.30	6.81
_10.40_	_5.27_	10.43	5.30	10.50	5.35	10.40	6.35	10.43	6.41	10.50	6.47
_11.00_	_5.27_	_11.03_	_5.25_	_11.10_	_5.24_	11.00	6.14	11.03	6.19	11.10	6.18
11.20	5.34	11.23	5.31	11.30	5.31	11.20	5.91	11.23	5.94	11.30	5.94
11.40	5.56	11.43	5.55	11.50	5.56	11.40	5.84	11.43	5.84	11.50	5.81
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	5.92	12.03	5.94	12.10	5.89	_12.00_	_5.70_	_12.03_	_5.69_	_12.10_	_5.70_
12.20	6.37	12.23	6.34	12.30	6.28	12.20	5.75	12.23	5.76	12.30	5.78
12.40	6.89	12.43	6.84	12.50	6.71	12.40	5.93	12.43	5.92	12.50	5.92
1.00	7.25	1.03	7.24	1.10	7.05	1.00	6.15	1.03	6.14	1.10	6.12
1.20	7.79	1.23	7.70	1.30	7.63	1.20	6.55	1.23	6.53	1.30	6.50
1.40	8.50	1.43	8.35	1.50	8.09	1.40	6.98	1.43	6.94	1.50	6.88
2.00	9.00	2.03	8.85	2.10	8.56	2.00	7.42	2.03	7.36	2.10	7.27
2.20	9.50	2 23	9.35	2.30	9.08	2.20	7.87	2.23	7.81	2.30	7.72
2.40	10.00	2.43	9.85	2.50	9.48	2.40	8.33	2.43	8.27	2.50	8.15
3.00	10.40	3.03	10.28	3.10	9.92	3.00	8.65	3.03	8.59	3.10	8.42
3.20	10.69	3.23	10.59	3.30	10.25	3.20	9.11	3.23	9.04	3.30	8.90
3.40	11.05	3.43	10.96	3.50	10.63	3.40	9.57	3.43	9.50	3.50	9.33
_4.00_	_11.24_	_4.03_	_11.11_	4.10	10.88	4.00	9.90	4.03	9.83	4.10	9.66
4.20	11.09	4.23	11.01	_4.30_	_10.90_	4.20	10.29	4.23	10.19	4.30	9.96
4.40	10.77	4.43	10.76	4.50	10.70	4.40	10.43	4.43	10.35	4.50	10.18
5.00	10.51	5.03	10.50	5.10	10.50	_5.00_	_10.49_	_5.03_	_10.43_	5.10	10.31
5.20	10.22	5.23	10.20	5.30	10.25	5.20	10.39	5.23	10.34	_5.30_	_10.35_
5.40	9.92	5.43	9.94	5.50	10.05	5.40	10.25	5.43	10.20	5.50	10.23
6.00	9.78	6.03	9.78	6.10	9.87	6.00	10.05	6.03	10.02	6.10	10.08
6.20	9.77	6.23	9.77	6.30	.....	6.20	.....	6.23	.....	6.30	......
_*11.50_	_6.04_	_*11.56_	_6.05_								

Error of float 0.04 subtractive.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 9.						*Tuesday, September 10.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M		A. M.	
*_0.15_	_10.63_	*_0.20_	_10.60_	*_0.25_	_10.58_	*_1.15_	_10.48_	*_1.24_	_10.43_	*_1.29_	_10.41_
5.20	7.27	5.23	7.35	5.30	7.39	5.20	7.71	5.23	7.77	5.30	7.81
5.40	6.97	5.43	7.03	5.50	7.02	5.40	7.36	5.43	7.43	5.50	7.45
6.00	6.59	6.03	6.66	6.10	6.70	6.00	7.06	6.03	7.10	6.10	7.14
6.20	6.46	6.23	6.50	6.30	6.51	6.20	6.72	6.23	6.78	6.30	6.81
_6.40_	_6.39_	_6.43_	_6.39_	_6.50_	_6.41_	6.40	6.49	6.43	6.51	6.50	6.55
7.02	6.52	7.05	6.48	7.10	6.51	7.00	6.26	7.03	6.29	7.10	6.30
7.20	6.68	7.23	6.66	7.30	6.64	_7.20_	_6.18_	_7.23_	_6.18_	_7.30_	_6.20_
7.40	6.85	7.43	6.84	7.50	6.88	7.40	6.21	7.43	6.21	7.50	6.25
8.00	7.10	8.03	7.09	8.10	7.09	8.00	6.35	8.03	6.33	8.10	6.36
8.20	7.44	8.23	7.43	8.30	7.42	8.20	6.56	8.23	6.59	8.30	6.66
8.40	7.80	8.43	7.77	8.50	7.71	8.40	6.85	8.43	6.84	8.50	6.84
9.00	8.02	9.03	8.09	9.10	8.05	9.00	7.18	9.03	7.17	9.10	7.18
9.20	8.48	9.23	8.41	9.30	8.36	9.20	7.58	9.23	7.54	9.30	7.55
9.40	8.75	9.43	8.81	9.50	8.71	9.40	7.98	9.43	7.94	9.50	7.87
10.00	9.24	10.03	9.20	10.10	9.06	10.00	8.39	10.03	8.37	10.10	8.27
10.20	9.60	10.23	9.58	10.30	9.42	10.20	8.81	10.23	8.74	10.30	8.63
10.40	10.08	10.43	10.01	10.50	9.81	10.40	9.26	10.43	9.20	10.50	9.04
11.00	10.49	11.03	10.43	11.10	10.18	11.00	9.72	11.03	9.65	11.10	9.43
11.20	10.79	11.23	10.73	11.30	10.48	11.20	10.02	11.23	10.02	11.30	9.80
11.40	10.99	11.43	10.90	11.50	10.75	11.40	10.45	11.43	10.39	11.50	10.15
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
_12.00_	_11.12_	_12.03_	_11.04_	_12.10_	_10.90_	12.00	10.76	12.03	10.68	12.10	10.48
12.20	10.98	12.23	10.93	_12.30_	_10.90_	12.20	10.85	12.23	10.79	12.30	10.67
12.40	10.90	12.43	10.88	12.50	10.87	_12.40_	_10.98_	_12.43_	_10.94_	_12.50_	_10.85_
1.00	10.70	1.03	10.67	1.10	10.65	1.00	10.89	1.03	10.84	1.10	10.82
1.20	10.37	1.23	10.35	1.30	10.39	1.20	10.73	1.23	10.70	1.30	10.71
1.40	10.04	1.43	10.05	1.50	10.10	1.40	10.55	1.43	10.50	1.50	10.53
2.00	9.70	2.03	9.73	2.10	9.80	2.00	10.27	2.03	10.27	2.10	10.32
2.20	9.47	2.23	9.48	2.30	9.55	2.20	10.00	2.23	9.97	2.30	10.02
2.40	9.25	2.43	9.28	2.50	9.31	2.40	9.62	2.43	9.66	2.50	9.75
3.00	9.01	3.03	9.02	3.10	9.05	3.00	9.46	3.03	9.45	3.10	9.52
3.20	8.82	3.23	8.88	3.30	8.85	3.20	9.22	3.23	9.28	3.30	9.31
3.40	8.64	3.43	8.63	3.50	8.61	3.40	9.05	3.43	9.11	3.50	9.07
4.00	8.44	4.03	8.42	4.10	8.42	4.00	8.86	4.03	8.90	4.10	8.87
4.20	8.20	4.23	8.18	4.30	8.13	4.20	8.67	4.23	8.69	4.30	8.79
4.40	7.82	4.43	7.85	4.50	7.87	4.40	8.49	4.43	8.47	4.50	8.45
5.00	7.55	5.03	7.56	5.10	7.55	5.00	8.18	5.03	8.18	5.10	8.17
5.20	7.18	5.23	7.22	5.30	7.20	5.20	7.85	5.23	7.88	5.30	7.88
5.40	6.89	5.43	6.93	5.50	6.93	5.40	7.48	5.43	7.52	5.50	7.52
6.00	6.61	6.03	6.62	6.10	6.60	6.00	7.16	6.03	7.20	6.10	7.23
6.20	6.35	6.23	6.35	6.30	6.38	6.20	6.85	6.23	6.87	6.30	6.91
6.40	6.21	6.43	6.21	6.50	6.20	6.40	6.57	6.43	6.60	6.50	6.62
_7.00_	_6.16_	_7.03_	_6.14_	_7.10_	_6.18_	*_7.57_	_6.25_	*_8.02_	_6.25_	*_8.08_	_6.28_

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 11.						*Thursday. September 12.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No 3.	
TIME.	READING.	TIME.	READING	TIME.	READING.	TIME	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
_*1.32_	_10.98_	_*1.44_	_10.88_	_*1.50_	_10.82_	_*2.00_	_10.89_	_*2.15_	_10.75_	_*2.21_	_10.70_
5.20	8.21	5.23	8.23	5.30	8.27	5.20	......	5.23	......	5.30	8.35
5.40	7.84	5.43	7.89	5.50	7.93	5.40	7.98	5.43	8.00	5.50	8.07
6.00	7.44	6.03	7 51	6.10	7.57	6 00	7.55	6.03	7.63	6.10	7.68
6.20	7.13	6.23	7.19	6.30	7.23	6.20	7.25	6 23	7.30	6.30	7.37
6.40	6.84	6.43	6.87	6.50	6.91	6.40	6.99	6.43	7.04	6.50	7.06
7.00	6.57	7.03	6.59	7.10	6.62	7.00	6.75	7.03	6.80	7.10	6.76
7.20	6.37	7.23	6.38	7.30	6.40	7.20	6.44	7.23	6.44	7.30	6.48
_7.40_	_6.23_	7.43	6.23	7.50	6.23	7.40	6.25	7.43	6.26	7.50	6.28
8.00	6.29	_8.03_	_6.19_	_8.10_	_6.22_	8.00	6.14	8.03	6.11	8.10	6.10
8.20	6.16	8.23	6.33	8.30	6.31	8.20	5.92	8.23	5.94	8.30	5.95
8.40	6.49	8.43	6.50	8.50	......	_8.40_	_5.86_	_8.43_	_5.85_	_8.50_	_5.89_
9.00	6.75	9.03	6.74	9.10	6.76	9.00	5.96	9.03	5.95	9.10	6.00
9.20	6.87	9.23	6.91	9.30	6.93	9.20	6.19	9.23	6.14	9.30	6.17
9.40	7.16	9.43	7.13	9.50	7.23	9.40	6.30	9.43	6.29	9.50	6.33
10.00	7.53	10.03	7.51	10.10	7.50	10.00	6.45	10.03	6.45	10.10	6.51
10.20	7.99	10.23	7.91	10.30	7.85	10.20	6.75	10.23	6.76	10.30	6.76
10.40	8.44	10.43	8.38	10.50	8.26	10.40	7.13	10.43	7.16	10.50	7.10
11.00	8.87	11.03	8.85	11.10	8.64	11.00	7.55	11.03	7.53	11.10	7.46
11.20	9.31	11.23	9.28	11.30	9.04	11.20	8.05	11.23	7.98	11.30	7.86
11 40	9.78	11.43	9.70	11.50	9.45	11.40	8.51	11.43	8.45	11.50	8.27
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.23	12.03	10.14	12.10	9.83	12.00	8.95	12.03	8.88	12.10	8.65
12.20	10.51	12.23	10.43	12.30	10.17	12 20	9.36	12.23	9.30	12.30	9.06
12.40	10.83	12.43	10.74	12.50	10.53	12.40	9.79	12.43	9.70	12.50	8.44
1.00	11.02	1.03	10.96	1.10	10.80	1.00	10.12	1.03	10.07	1.10	9.84
1.20	11.18	1.23	11.13	1.30	11.01	1.20	10.45	1.23	10.39	1.30	10.27
_1.40_	_11.23_	_1.43_	_11.18_	_1.50_	_11.10_	1.40	10.71	1.43	10.61	1.50	10.42
2.00	11.14	2.03	11.09	2.10	11.07	_2.00_	_10.83_	_2.03_	_10.74_	_2.10_	_10.57_
2.20	10.95	2.23	10.90	2.30	10.85	2.20	10.78	2.23	10.69	_2.30_	_10.57_
2.40	10.57	2.43	10.55	2.50	10.59	2.40	10.44	2.43	10.39	2.50	10.36
3.00	10.23	3.03	10.23	3.10	10.31	3.00	10.16	3.03	10.11	3.10	10.14
3.20	9.88	3.23	9.93	3.30	10.01	3.20	9.88	3.23	9.85	3.30	9.83
3.40	9.58	3.43	9.62	3.50	9.71	3 40	9.61	3.43	9.64	3.50	9.72
4.00	9.36	4.03	9.40	4.10	9.50	4.00	9.38	4.03	9.41	4.10	9 45
4.20	9.29	4.23	9.30	4.30	9.33	4.20	9.19	4.23	9.23	4.30	9.24
4.40	9.11	4.43	9.13	4.50	9.13	4.40	9.08	4.43	9.05	4.50	9.09
5.00	8.84	5.03	8.81	5.10	8.82	5.00	8.98	5.03	8.97	5.10	8 97
5.20	8.44	5.23	8.46	5.30	8.50	5.20	8.81	5.23	8.76	5.30	8.75
5.40	8.06	5.43	8.13	5.50	8.18	5.40	8.60	5.43	8 55	5.50	8.53
6.00	7.76	6.03	7.81	6.10	7.85	6.00	8.34	6.03	8.33	6.10	8.33
6.20	7.48	6.23	7.51	6.30	7.53	6.20	7.96	6.23	8.03	6.30	8.09
6 40	7.07	6.43	7.19	6.50	7.16	6.40	7.85	6.43	7.83	6.50	7.83
_*8.30_	_6.18_	_*8.35_	_6.18_	_*8.40_	_6.23_	_*9.00_	_6.37_	_*9.05_	_6.38_	_*9.10_	_6.41_

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 13.						*Saturday, September 14.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*2.20	11.03	*2.34	10.90	*2.41	10.82	*3.15	11.04	*3.30	10.90	*3.36	10.86
5.20	......	5.23	......	5.30	......	5.20	9.23	5.23	9.28	5.30	9.36
5.40	8.20	5.43	8.22	5.50	8.25	5.40	9.00	5.43	9.03	5.50	9.11
6.00	8.12	6.03	8.10	6.10	8.05	6.00	8.73	6.03	8.72	6.10	8.80
6.20	7.69	6.23	7.70	6.30	7.71	6.20	8.38	6.23	8.39	6.30	8.45
6.40	7.49	6.43	7.51	6.50	7.56	6.40	8.19	6.43	8.21	6.50	8.24
7.00	7.32	7.03	7.31	7.10	7.31	7.00	7.89	7.03	7.90	7.10	7.90
7.20	7.05	7.23	7.08	7.30	7.09	7.20	7.57	7.23	7.61	7.30	7.60
7.40	6.85	7.43	6.89	7.50	6.85	7.40	7.35	7.43	7.39	7.50	7.40
8.00	6.63	8.03	6.61	8.10	6.60	8.00	7.09	8.03	7.10	8.10	7.10
8.20	6.36	8.23	6.36	8.30	6.39	8.20	6.88	8.23	6.89	8.30	6.87
8.40	6.20	8.43	6.21	8.50	6.18	8.40	6.65	8.43	6.65	8.50	6.66
9.00	5.95	9.03	5.98	9.10	5.99	9.00	6.59	9.03	6.57	9.10	6.58
9.20	5.88	9.23	5.88	9.30	5.89	9.20	6.45	9.23	6.39	9.30	6.41
9.40	5.81	9.43	5.83	9.50	5.82	9.40	6.41	9.51	6.42	9.55	6.45
10.00	5.90	10.03	5.91	10.10	5.89	10.00	6.49	10.03	6.45	10.10	6.46
10.20	6.05	10.23	6.06	10.30	6.01	10.20	6.56	10.23	6.54	10.30	6.62
10.40	6.35	10.43	6.39	10.50	6.39	10.40	6.80	10.43	6.80	10.50	6.81
11.00	6.79	11.03	......	11.10	6.69	11.00	7.08	11.03	7.10	11.10	7.07
11.20	7.21	11.23	7.18	11.30	7.09	11.20	7.37	11.23	7.38	11.30	7.39
11.40	7.71	11.43	7.68	11.50	7.55	11.40	7.85	11.43	7.82	11.50	7.76
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	8.06	12.03	7.98	12.10	7.85	12.00	8.26	12.03	8.21	12.10	8.07
12.20	8.41	12.23	8.58	12.30	8.25	12.20	8.58	12.23	8.55	12.30	8.40
12.40	8.91	12.43	8.85	12.50	8.65	12.40	8.96	12.43	8.89	12.50	8.80
1.00	9.25	1.03	9.21	1.10	9.02	1.00	9.30	1.03	9.25	1.10	9.14
1.20	9.60	1.23	9.55	1.30	9.34	1.20	9.58	1.23	9.54	1.30	9.34
1.40	9.93	1.43	9.87	1.50	9.78	1.40	9.93	1.43	9.90	1.50	9.78
2.00	10.24	2.03	10.16	2.10	10.01	2.00	10.28	2.03	10.26	2.10	10.07
2.20	10.29	2.23	10.24	2.30	10.18	2.20	10.54	2.23	10.49	2.30	10.40
2.40	10.27	2.43	10.23	2.50	10.16	2.40	10.80	2.43	10.83	2.50	10.59
3.00	10.10	3.03	10.09	3.10	10.10	3.00	10.94	3.03	10.88	3.10	10.78
3.20	10.03	3.23	10.00	3.30	10.01	3.20	10.96	3.23	10.91	3.30	10.95
3.40	9.56	3.43	9.57	3.50	9.63	3.40	10.75	3.43	10.68	3.50	10.71
4.00	9.23	4.03	9.25	4.10	9.33	4.00	10.50	4.03	10.50	4.10	10.52
4.20	8.82	4.23	8.88	4.30	9.00	4.20	10.25	4.23	10.26	4.30	10.32
4.40	8.69	4.43	8.72	4.50	8.78	4.40	10.03	4.43	10.05	4.50	10.14
5.00	8.54	5.03	8.54	5.10	8.53	5.00	9.87	5.03	9.88	5.10	9.93
5.20	8.45	5.23	8.44	5.30	8.46	5.20	9.71	5.23	9.73	5.30	9.78
5.40	8.43	5.43	8.37	5.50	8.35	5.40	9.60	5.43	9.59	5.50	9.62
6.00	8.19	6.03	8.15	6.10	8.13	6.00	9.41	6.03	9.38	6.10	9.37
6.20	7.99	6.23	7.97	6.30	7.95	6.20	9.16	6.23	9.17	6.30	9.16
6.40	7.68	6.43	7.66	6.50	7.64	6.40	8.95	6.43	8.91	6.50	8.94
*9.15	5.92	*9.20	5.92	*9.25	5.96	*10.20	7.18	*10.25	7.18	*10.30	7.21

*Sunday, September 15, A. M.**						*Sunday, September 15, P. M.**					
3.14	11.25	3.33	11.12	3.40	11.09	3.35	11.20	3.48	11.09	3.54	11.05
10.37	7.07	10.41	7.07	10.46	7.12	10.40	7.30	10.50	7.30	10.57	7.33

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 16.						Tuesday, September 17.					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
Time.	Reading.	Time.	Read'g.	Time.	Read'g.	Time.	Reading.	Time.	Reading.	Time.	Read'g.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*4.00	11.22	*4.05	11.19	*4.10	11.15	*4.45	10.50	*4.49	10.48	*4.55	10.45
5.20	9.81	5.23	9.85	5.30	9.98	5 20	10.09	5.23	10.08	5.30	10.14
5.40	9.65	5.43	9.69	5.50	9.82	5.40	9.77	5.43	9.80	5.50	9.86
6.00	9.41	6.03	9.45	6.10	9.59	6.00	9.44	6.03	9.48	6.10	9.55
6.20	9.21	6.23	9.27	6.30	9.36	6.20	9.16	6.23	9.21	6.30	9.28
6.40	9.02	6.43	9.06	6.50	9.12	6.40	8.84	6.43	8.90	6.50	8.97
7.00	8.85	7.03	8.88	7.10	8.94	7.00	8.64	7.03	8.68	7.10	8.75
7.20	8.66	7.23	8.66	7.30	8.68	7.20	8.50	7.23	8.50	7.30	8.53
7.40	8.42	7.43	8.42	7.50	8 46	7.40	8.38	7.43	8.38	7.50	8.40
8.00	8.23	8.03	8.23	8.10	8.24	8.00	8.33	8.03	8.31	8.10	8.30
8.20	8.02	8.23	8.01	8.30	8.03	8.20	8.19	8.23	8.15	8.30	8 13
8.40	7.79	8.43	7.80	8.50	7.80	8.40	8.04	8.43	8.03	8.50	8.03
9.00	7.50	9.03	7.50	9.10	7.53	9.00	7.91	9.03	7.89	9.10	7.86
9.20	7.33	9.23	7.33	9.30	7.36	9.20	7.65	9.23	7.65	9.30	7.67
9.40	7.08	9.43	7.10	9.50	7.09	9.40	7.47	9.43	7.50	9.50	7.47
10.00	6.91	10.03	6.93	10.10	6.93	10.00	7.29	10.03	7.28	10.10	7.27
10.20	6.76	10.23	6.75	10.30	6.73	10.20	7.20	10.23	7.19	10.30	7.19
10.40	6.63	10.43	6.61	10.50	6.64	10.40	7.00	10.43	6.99	10.50	6 99
11.00	6.64	11.03	6.62	11.10	6.63	11.00	6.85	11.03	6.85	11.10	6.90
11.20	6.67	11.23	6.66	11.30	6.71	11.20	6.80	11.23	6.79	11.30	6.79
11.40	6.86	11.43	6.84	11.50	6.87	11.40	6.78	11.43	6.75	11.50	6.80
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.01	12.03	6.99	12.10	7.07	12.00	6.79	12.03	6.75	12.10	6.80
12.20	7.31	12.23	7.31	12.30	7.36	12.20	6.84	12.23	6.82	12.30	6.86
12.40	7.62	12.43	7.60	12.50	7.60	12.40	6.90	12.43	6.89	12.50	6.93
1.00	7.88	1.03	7.86	1.10	7.86	1.00	7.03	1.03	6.98	1.10	7.05
1.20	8.15	1.23	8.13	1.30	8.15	1.20	7.29	1.23	7.21	1.30	7.28
1.40	8.51	1.43	8.49	1.50	8.46	1.40	7.55	1.43	7.48	1.50	7.51
2.00	8.89	2.03	8.85	2.10	8.77	2.00	7.89	2.03	7 85	2.10	7.83
2.20	9.35	2.23	9.28	2.30	9.15	2.20	8.20	2.23	8.20	2 30	8.15
2.40	9.74	2.43	9.68	2.50	9.49	2.40	8.67	2.43	8.62	2.50	8.52
3.00	10.07	3.03	10.02	3.10	9.85	3.00	9.01	3.03	8.96	3.10	8.86
3.20	10.29	3.23	10.24	3.30	10.08	3.20	9.36	3.23	9.31	3.30	.....
3.40	10.54	3.43	10.50	3.50	10.34	3.40	9.75	3.43	9.69	3.50	9.53
4.00	10.61	4.03	10.57	4.10	10.44	4.00	10.10	4.03	10.08	4.10	.....
4.20	10.45	4.23	10.39	4.30	10.35	4.20	10.31	4.23	10.29	4.30	.....
4.40	10.26	4.43	10.21	4.50	10.26	4.40	10.30	4.43	10.27	4.50	10.24
5.00	10.07	5.03	10.04	5.10	10.09	5.00	10.28	5.03	10.24	5.10	.....
5.20	9.83	5.23	9.82	5.30	9.88	5.20	10.14	5.23	10.12	5.30	10.10
5.40	9.63	5.43	9.62	5.50	9.68	5.40	9.99	5.43	9.97	5.50	9.92
6.00	9.39	6.03	9.39	6.10	9.43	6.00	......	6.03	......	6.10	.....
6.20	9.25	6.23	9.23	6.30	9.27	6.20	......	6.23	......	6.30	.....
6.40	......	6.43	.....	6.35	9.20	6.40	......	6.43	......	6.50	.....
*11.20	6.97	*11.25	6.98	*11.31	7.01						

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 18.						*Thursday, September 19.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*0.10	*7.17*	*0.16	*7.19*	*0.23	*7.20*	*0.50	*7.24*	*0.55	*7.26*	*1.01	*7.29*
5.20	*10.48*	*5.23*	*10.43*	*5.30*	*10.44*	5.20	......	5.23	......	5.30	10.27
5.40	10.35	5.43	10.33	5.50	10.35	*5.40*	*10.34*	*5.43*	*10.29*	*5.50*	*10.30*
6.00	10.19	6.03	10.18	6.10	10.22	6.00	10.29	6.03	10.24	*6.10*	*10.30*
6.20	9.95	6.23	9.96	6.30	9.99	6.20	10.27	6.23	10.24	6.30	10.29
6.40	9.67	6.43	9.70	6.50	9.75	6.40	10.26	6.47	10.24	6.50	10.27
7.00	9.43	7.03	9.45	7.10	9.49	7.00	10.16	7.03	10 10	7.10	10.12
7.20	9.19	7.23	9.19	7.30	9.23	7.20	9.90	7.23	9.87	7.30	9.90
7.40	8.96	7.43	8.99	7.50	9.03	7.40	9.69	7.43	9.68	7.50	9 70
8.00	8.82	8.03	8.83	8.10	8.82	8.00	9.44	8.03	9.41	8.10	9.45
8.20	8.61	8.23	8.60	8.30	8.58	8.20	9.15	8.23	9.15	8.30	9.19
8.40	8.43	8.43	8.43	8.50	8.42	8.40	8.90	8.43	8.91	8.50	8.94
9.00	8.26	9.03	8.24	9.10	8.25	9.00	8.74	9.03	8.75	9.10	8.75
9.20	8.17	9.23	8.15	9.30	8.14	9.20	8.56	9.23	8.55	9.30	8.55
9.40	8.07	9.43	8.05	9.50	8.00	9.40	8.42	9.43	8.44	9.50	8.43
10.00	7.90	10.03	7.87	10.10	7.90	10.00	8.30	10.03	8.32	10.10	8.31
10.20	7.82	10.23	7.80	10.30	7.80	10.20	8.26	10.23	8.24	10.30	8.28
10.40	7.69	10.43	7.65	10.50	7.64	10.40	8.21	10.43	8.19	10.50	8.18
11.00	7.64	11.03	7.61	11.10	7.59	11.00	8.14	11.03	8.11	11.10	8.11
11.20	7.49	11.23	7.45	11.30	7.47	11.20	7.98	11.23	7.94	11.30	7.93
11.40	7.41	11.43	7.41	11.50	7.45	11.40	7.73	11.43	7.73	11.50	7.74
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.40	12.03	7.36	12.10	7.37	12.00	7.48	12.03	7.49	12.10	7.53
12.20	7.32	12.23	7.30	12.30	7.33	12.20	7.32	12.23	7.35	12.30	7.39
12.40	7.26	12.43	7.25	12.50	7.27	12.40	7.24	12.43	7.22	12.50	7.22
1.00	*7.22*	*1.03*	*7.21*	*1.10*	*7.25*	1.00	7.02	1.03	7.01	1.10	7.03
1.20	7.26	1.23	7.23	1.30	7.28	1.20	6.94	1.23	6.93	1.30	6.97
1.40	7.34	1.43	7.31	1.50	7.34	*1.40*	*6.85*	*1.43*	*6.84*	*1.50*	*6.88*
2.00	7.53	2.03	7.51	2.10	7.54	2.00	6.97	2.03	6.95	2.10	6.99
2.20	7.74	2.23	7.70	2.30	7.73	2.20	7.11	2.23	7.09	2.30	7.12
2.40	8.00	2.43	8.01	2.50	8.02	2.40	7.35	2.43	7.33	2.50	7.35
3.00	8.42	3.03	8.38	3.10	8.31	3.00	7.57	3.03	7.53	3.10	7.56
3.20	8.70	3.23	8.66	3.30	8.57	3.20	7.82	3.23	7.77	3.30	7.80
3.40	9.05	3.43	9.01	3.50	8.91	3.40	8.09	3.43	8.06	3.50	8.06
4.00	9.37	4.03	9.34	4.10	9.20	4.00	8.39	4.03	8.35	4.10	8.32
4.20	9.69	4.23	9.67	4.30	9.52	4.20	8.69	4.23	8.64	4.30	8.60
4.40	10.04	4.43	9.99	4.50	9.85	4.40	9.14	4.43	9.08	4.50	8.95
5.00	10.20	5.03	10.16	5.10	10.02	5.00	9.41	5.03	9.37	5.10	9.23
5.20	10.23	*5.23*	*10.24*	5.30	10.18	5.20	9.63	5.23	9.59	5.30	9.48
5.40	*10.27*	5.43	10 22	*5.50*	*10 20*	*5 40*	*9.78*	*5.43*	*9.73*	*5.50*	*9.66*
6.00	10.13	6.03	10.08	6.10	10.10	6.00	9.71	6.03	9.64	*6.10*	*9.66*
6.20	9.93	6.23	9.89	6.30	9.91	6.20	9.65	6.23	9.61	*6.30*	*9.66*
6.40	9.66	6.43	9.65	6.50	9.72	6.40	9.60	6.43	9.61	6.50	9.62

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 20.						*Saturday, September 21.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*1.50	6.97	*1.54	6.97	*2.00	7.03	*3.00	6.84	*3.05	6.84	*3.12	6.90
5.20	9.55	5.23	9.50	5.30	9.46	5.20	8.68	5.23	8.66	5.30	8.63
5.40	9.76	5.43	9.72	5.50	9.68	5.40	8.99	5.43	8.98	5.50	8.92
6.00	9.88	6.03	9.83	6.10	9.83	6.00	9.25	6.03	9.22	6.10	9.18
6 20	9.96	6.23	9.92	6.30	9.94	6.20	9.52	6.23	9.49	6.30	9.43
6.40	9.95	6.43	9.90	6 50	9.95	6.40	9.70	6.43	9.67	6.50	9.62
7.00	9.92	7.03	9.89	7.10	9.93	7.00	9.80	7.03	9.76	7 10	9.78
7.20	9.90	7.23	9.89	7.30	9.92	7.20	9.90	7.23	9.88	7.30	9.90
7.40	9.82	7.43	9.80	7.50	9.80	7.40	10.00	7.43	9.96	7.50	9.99
8.00	9.66	8.03	9.61	8.10	9.62	8.00	10.02	8.03	9.96	8.10	9.98
8.20	9.43	8.23	9.42	8.30	9.45	8.20	9.91	7.23	9.85	8.30	9.89
8.40	9.20	8.43	9.20	8.50	9.24	8.40	9.80	8.43	9.75	8.50	9.79
9.00	9.05	9.03	9.03	9.10	9.06	9.00	9.66	9.03	9.64	9.10	9.68
9.20	8 88	9.23	8.88	9.30	8.90	9.20	9.55	9.23	9.54	9.30	9.55
9.40	8 82	9.43	8.79	9.50	8.80	9.40	9.35	9.43	9.31	9.50	9.31
10.00	8.73	10.03	8.69	10.10	8.72	10.00	9.13	10.03	9.13	10.10	9.17
10.20	8.62	10.23	8.59	10.30	8.57	10.20	9.04	10.23	9.02	10.30	9.01
10.40	8.48	10.43	8.47	10.50	8.46	10.40	8.91	10.43	8.84	10.50	8.87
11.00	8.36	11.03	8.35	11.10	8.36	11.00	8.84	11.03	8.81	11.10	8.82
11.20	8.17	11.23	8.19	11.30	8.20	11.20	8.75	11.23	8.70	11.30	8.71
11.40	8.16	11.43	8.14	11.50	8.11	11.40	8.65	11.43	8.62	11.50	8.64
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	7.94	12.03	7.91	12.10	7.89	12.00	8.50	12.03	8.47	12.10	8.48
12.20	7.70	12.23	7.72	12.30	7.75	12.20	8.35	12.23	8.34	12.30	8.37
12.40	7.47	12.43	7.47	12.50	7.48	12.40	8.21	12.43	8.21	12.50	8.23
1.00	7.19	1,03	7.20	1.10	7.23	1.00	7.98	1.03	7.98	1.10	7.99
1.20	6.95	1.23	6.99	1.30	7.01	1.20	7.72	1.23	7.73	1.30	7.74
1.40	6.81	1.43	6.82	1.50	6.83	1.40	7.41	1.43	7.43	1.50	7.46
2.00	6.77	2.03	6.72	2.10	6.75	2.00	7.20	2.03	7.21	2.10	7.25
2.20	6.78	2.23	6.74	2.30	6.77	2.20	7.14	2.23	7.15	2.30	7.15
2.40	6.84	2.43	6.81	2.50	6.83	2.40	6.96	2.43	6.94	2.50	6.97
3.00	6.94	3.03	6.90	3.10	6.92	3.00	6.88	3.03	6.85	3.10	6.87
3.20	7.10	3.23	7.09	3.30	7.13	3.20	6.78	3.23	6.76	3.30	6.77
3.40	7.27	3.43	7.24	3.50	7.27	3.40	6.78	3.43	6.78	3.50	6.81
4 00	7.56	4.03	7.56	4.10	7.57	4.00	6.83	4.03	6.80	4.10	6.86
4.20	7.86	4.23	7.80	4.30	7.81	4.20	6.93	4.23	6.90	4.30	6,95
4.40	8.16	4.43	8.14	4.50	8.13	4.40	7.15	4.43	7.13	4.50	7.16
5.00	8.43	5.03	8.39	5.10	8.35	5.00	7.37	5.03	7.36	5.10	7.37
5.20	8.72	5.23	8.67	5.30	8.62	5.20	7.69	5.23	7.67	5.30	7.67
5.40	8.95	5.43	8.94	5.50	8.87	5.40	7.97	5.43	7.93	5.50	7.91
6.00	9.12	6.03	9.11	6.10	9.07	6.00	8.19	6.03	8.18	6.10	8.17
6.20	9.29	6.23	9.25	6.30	9.23	6.20	8.53	6.23	8.51	6.30	8.48
6.40	9.37	6.43	9.32	6.50	9.31	6.40	8.85	6.43	8.85	6.50	8.80
*8.11	9.45	*8.17	9.43	*8.25	9.39	*8.55	10.17	*9.02	10.15	*9.10	10.11

*Sunday, September 22, A. M.**						*Sunday, September 22, P. M.**					
4.00	7.22	4.06	7.23	4.14	7.27	4.20	6.43	4.25	6.44	4.30	6.48
10.02	10.50	10.09	10.45	10.14	10.43	11.08	10.68	11.12	10.65	11.20	10.65

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 23.						*Tuesday, September 24.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*_5.05_	_6.50_	*_5.10_	_6.51_	*_5.16_	_6.53_						
5.20	6.55	5.23	6.54	5.30	6.60	5 20	......	5.23	......	5.30	6.21
5.40	6.80	5.43	6.80	5.50	6.83	_5.40_	_6.02_	_5.43_	_6.02_	_5.50_	_6.04_
6.00	7.21	6.03	7.17	6.10	7.17	6.00	6.06	_6.03_	_6.02_	6.10	6.06
6.20	7.63	6.23	7.57	6.30	7.52	6.20	6.19	6.23	6.18	6.30	6.22
6.40	8.10	6.43	8.02	6.50	7.93	6.40	6.51	6.43	6.48	6.50	6.50
7.00	8.45	7.03	8.38	7.10	8.27	7.00	6.84	7.03	6.80	7.10	6.81
7.20	8.80	7.23	8.75	7.30	8 64	7.20	7.27	7.23	7.23	7.30	7.18
7.40	9.16	7.43	9.09	7.50	8.99	7.40	7.59	7.43	7.54	7.50	7.56
8.00	9.51	8.03	9.45	8.10	9.35	8.00	8.05	8.03	8.00	8.10	7.91
8.20	9.88	8.23	9.80	8.30	9.70	8.20	8.48	8.23	8.40	8.30	8 26
8.40	10.10	8.43	10.05	8.50	9.92	8.40	8.88	8.43	8.82	8.50	8.64
9.00	10.38	9.03	10.34	9.10	10.23	9.00	9.30	9.03	9.20	9.10	9.00
9.20	10.62	9.23	10.56	9.30	10.48	9.20	9.58	9.23	9.50	9.30	9.37
9.40	10.81	9.43	10.76	9.50	10.71	9.40	10.00	9.43	9.94	9.50	9.74
10.00	11.01	10.03	10.97	10.10	10.90	10.00	10.32	10.03	10.22	10.10	10.10
_10.20_	_11.07_	_10.23_	_11.02_	10.30	10.97	10.20	10.67	10.23	10.58	10.30	10 40
10.40	11.00	10.43	10.97	_10.50_	_10.98_	10.40	10.94	10.43	10.87	10.50	10.66
11.00	10.95	11.03	10.98	11.10	10.93	11.00	11.14	11.03	11.10	11.10	10.95
11.20	10.74	11.23	10.71	11.30	10.75	11.20	11.42	11.23	11.36	11.30	11.22
11.40	10.48	11.43	10.45	11.50	10.52	_11.40_	_11.47_	_11.43_	_11.42_	_11.50_	_11.30_
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.12	12.03	10.18	12.10	10.26	12.00	11.23	12.03	11.15	12.10	11.12
12.20	9.96	12.23	9.99	12.30	10.05	12.20	10.86	12.23	10.84	12.30	10.88
12.40	9.81	12.43	9.84	12.50	9.89	12.40	10.52	12.43	10.52	12.50	10.62
1.00	9.70	1.03	9.68	1.10	9.71	1.00	10.31	1.03	10.31	1.10	10.41
1.20	9.49	1.23	9.49	1.30	9.49	1.20	10.10	1.23	10.09	1.30	10.13
1.40	9.29	1.43	9.26	1.50	9.29	1.40	9.81	1.43	9.77	1.50	9.85
2.00	9.07	2.03	9.05	2.10	9.05	2.00	9.59	2.03	9.57	2.10	9.64
2.20	8.85	2.23	8.80	2.30	8.80	2.20	9.29	2.23	9.29	2 30	9.37
2.40	8.47	2.43	8.47	2.50	8.49	2.40	9.05	2.43	9.05	2.50	9.10
3.00	8.17	3.03	8.17	3.10	8.20	3.00	8.75	3.03	8.76	3.10	8.76
3.20	7.82	3.23	7.82	3.30	7.86	3.20	8.32	3.23	8.33	3.30	8.36
3.40	7.46	3.43	7.49	3.50	7.50	3.40	7.95	3.43	7.99	3.50	8.05
4.00	7.08	4.03	7.15	4.10	7.17	4.00	7.41	4.03	7.43	4.10	7.62
4.20	6.65	4.23	6.59	4.30	6.72	4.20	6.88	4.23	6.92	4.30	7.10
4.40	6.33	4.43	6.39	4.50	6.44	4.40	6.50	4.43	6.58	4.50	6.75
5.00	6.18	5.03	6.20	5.10	6.21	5.00	6.15	5.03	6.25	5.10	6.25
5.20	6.14	5 23	6.11	5.30	6.12	5.20	5.75	5.23	5.80	5.30	5.87
_5.40_	_6.13_	_5.43_	_6.10_	_5.50_	_6.11_	5.40	5.53	5.43	5.54	5.50	5.58
6.00	6.19	6.03	6.19	6.10	6 26	6.00	5.50	6.03	5.49	_6.10_	_5.47_
6.20	6.45	6.23	6.48	6.30	6.54	_6.25_	_5.48_	_6.28_	_5.48_	_6.40_	_5.47_
6.40	......	6.43	.....	6.50	.....						
*_11.33_	_10.94_	*_11.38_	_10.94_	*_11.45_	_10.89_						

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 25.						*Thursday, September 26.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**0.00*	*11.17*	**0.04*	*11.14*	**0.10*	*11.10*	**0.39*	*11.65*	**0.43*	*11.63*	**0.50*	*11.53*
5.20	6.21	5.23	6.39	5.30	6.53	5.20	......	5.23	......	5.30	7.45
5.40	5.80	5.43	5.97	5.50	6.10	5.40	6.46	5.43	6.68	5.50	6.94
6.00	5.56	6.03	5.65	6.10	5.72	6.00	5.83	6.03	6.10	6.10	6.34
6.20	5.44	6.23	5.48	6.30	5.50	6.20	5.29	6.23	5.55	6.30	5.75
6.40	*5.36*	*6.43*	*5.35*	*6.50*	*5.39*	6.40	4.86	6.43	5.07	6.50	5.24
7.00	5.50	7.03	5.49	7.10	5.51	7.00	4.56	7.03	4.70	7.10	4.80
7.20	5.75	7.23	5.72	7.30	5.73	*7.20*	*4.50*	7.23	4 54	7.30	4.58
7.40	6.15	7.43	6.12	7.50	6.11	7.40	4.57	*7.43*	*4.50*	*7.50*	*4 55*
8.00	6.60	8.03	6.55	8.10	6.47	8.00	4.72	8.03	4.70	8.10	4.71
8.20	7.00	8.23	6.94	8.30	6.86	8.20	5.10	8.23	5.07	8.30	5.10
8.40	7.44	8.43	7.36	8.50	7.25	8.40	5.50	8.43	5.44	8.50	5.41
9.00	7.92	9.03	7.84	9.10	7.70	9.00	5.95	9.03	5.89	9.10	5.82
9.20	8.37	9.23	8.30	9.30	8.12	9.20	6.40	9.23	6.35	9.30	6.26
9.40	8.87	9.43	8.81	9.50	8.58	9.40	6.82	9.43	6.77	9.50	6.70
10.00	9.45	10.03	9.32	10.10	9.04	10.00	......	10.03	......	10.10	7.24
10.20	9.94	10.23	9.84	10.30	9.50	10.20	8.20	10.23	8.08	10.30	.....
10.40	10.43	10.43	10.32	10.50	9.94	10.40	8.75	10.43	8.61	10.50	8.38
11.00	10.97	11.03	10.80	11.10	10.42	11.00	9.35	11.03	9.25	11.10	8.82
11.20	11.32	11.23	11.15	11.30	10.79	11.20	9.87	11.23	9.70	11.30	9.30
11.40	11.58	11.43	11.50	11.50	11.17	11.40	10.33	11.43	10.25	11.50	9.76
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	11.88	12.03	11.80	12.10	11.49	12.00	......	12.03	......	12.10	.....
12.20	*11.97*	*12.23*	*11.89*	12.30	11.71	12.20	11.13	12.23	11.05	12.30	10.60
12.40	11.87	12.43	11.80	*12.50*	*11.72*	12.40	11.37	12.43	11.28	12 50	10.95
1.00	11.60	1.03	11.55	1.10	11.52	*1.00*	*11.53*	*1.03*	*11.43*	1.10	11.19
1.20	11.26	1.23	11.22	1.30	11.28	1.20	11.41	1.23	11.32	*1.30*	*11.20*
1.40	10.95	1.43	10.91	1.50	10.98	1.40	11.05	1.43	11.10	1.50	11.05
2.00	10.63	2.03	10.62	2.10	10.72	2.00	10.74	2.03	10.72	2.10	10.77
2.20	10.35	2.23	10.36	2.30	10.39	2.20	10.32	2.23	10.30	2.30	10.53
2.40	10.09	2.43	10.10	2.50	10.15	2.40	10.17	2.43	10.18	2.50	10.30
3.00	9.85	3.03	9.86	3.10	10.10	3.00	10.12	3.03	10.14	3.10	10.18
3.20	9.62	3.23	9.63	3.30	9.74	3.20	10.01	3.23	10.02	3.30	10.09
3.40	9.21	3.43	9.25	3.50	9.32	3.40	9.90	3.43	9.87	3.50	9.90
4.00	8.79	4.03	8.84	4.10	8.90	4.00	9.70	4.03	9.70	4.10	9.68
4.20	8.34	4.23	8.41	4.30	8.48	4.20	9.41	4.23	9.39	4.30	9.37
4.40	7.85	4.43	7.93	4.50	8.04	4.40	9.00	4.43	9.00	4.50	8.95
5.00	7.32	5.03	7.42	5.10	7.59	5.00	8.57	5.03	8.60	5.10	8.63
5.20	6.71	5.23	6.81	5.30	6.97	5.20	8.08	5.23	8.11	5.30	8.25
5.40	6.25	5.43	6.35	5.50	6.49	5.40	7.45	5.43	7.49	5.50	7.60
6.00	5.75	6.03	5.85	6.10	5.99	6.00	6.85	6.03	7.00	6.10	7.20
6.20	5.42	6.23	5.60	6.30	5.65	**8.06*	*5.00*	**8.11*	*5.01*	**8.20*	*5.05*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 27.						Saturday, September 28.					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*1.40	12.40	*1.50	12.25	*1 55	12.15						
5.40	8.85	5.43	9.06	5.50	9.00	*2.25	12.56	*2.31	12.52	*2.37	12.36
6.00	8.25	6.03	8.41	6.10	8.50						
6.20	7.49	6.23	7.67	6.30	7.92						
6.40	6.81	6.43	7.03	6.50	7.31						
7.00	6.25	7.03	6.35	7.10	6.63						
7.20	5.84	7.23	6.00	7.30	6.17						
7.40	5.47	7.43	5.65	7.50	5.75						
8.00	5.17	8.03	5.30	8.10	5.35	8.00	6.05	8.03	6.21	8.10	6.40
8.20	5.17	8.23	5.18	8.30	5.19	8.20	5.59	8.23	5.70	8.30	5.85
8.40	5.21	8.43	5.17	8.50	5.17	8.40	5.20	8.43	5.35	8.50	5.44
9.00	5.44	9.03	5.42	9.10	5.40	9.00	5.01	9.03	5.07	9.10	5.10
9.20	5.86	9.23	5.86	9.30	5.77	9.20	5.02	9.23	5.01	9.30	4.99
9.40	6.41	9.43	6.32	9.50	6.22	9.40	5.01	9.43	5.01	9.50	5.00
10.00	6.88	10.03	6.80	10.10	6.66	10.00	5.21	10.03	5.21	10.10	5.20
10.20	7.36	10.23	7.28	10.30	7.03	10.20	5.49	10.23	5.51	10.30	5.55
10.40	7.91	10.43	7.81	10.50	7.60	10.40	5.94	10.43	5.94	10.50	5.93
11.00	8.41	11.03	8.36	11.10	8.03	11.00	6.59	11.03	6.58	11.10	6.43
11.20	8.97	11.23	8.85	11.30	8.60	11.20	7.12	11.23	7.00	11.30	6.85
11.40	9.64	11.43	9.52	11.50	9.14	11.40	7.75	11.43	7.65	11.50	7.40
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.26	12.03	10.16	12.10	9.66	12.00	8.41	12.03	8.30	12.10	7.92
12.20	10.75	12.23	10.58	12.30	10.10	12.20	9.04	12.23	8.80	12.30	8.52
12.40	11.29	12.43	11.15	12.50	10.55	12.40	9.67	12.43	9.47	12.50	9.01
1.00	11.64	1.03	11.50	1.10	11.00	1.00	10.26	1.03	10.10	1.10	9.59
1.20	11.90	1.23	11.80	1.30	11.36	1.20	10.78	1.23	10.58	1.30	10.09
1.40	12.01	1.43	11.89	1.50	11.60	1.40	11.30	1.43	11.07	1.50	10.59
2.00	11.98	2.03	11.90	2.10	11.73	2.00	11.65	2.03	11.53	2.10	10.99
2.20	11.75	2.23	11.65	2.30	11.58	2.20	11.89	2.23	11.72	2.30	11.34
2.40	11.24	2.43	11.22	2.50	11.23	2.40	11.89	2.43	11.80	2.50	11.52
3.00	10.96	3.03	......	3.10	......	3.00	11.76	3.03	11.67	3.10	11.55
3.20	10.80	3.23	10.80	3.30	10.89	3.20	11.41	3.23	11.36	3.30	11.32
3.40	10.86	3.43	10.83	3.50	10.87	3.40	11.15	3.43	11.16	3.50	11.19
4.00	10.90	4.03	10.85	4.10	10.88	4.00	11.03	4.03	11.01	4.10	11.06
4.20	10.90	4.23	10.89	4.30	10.87	4.20	10.95	4.23	10.94	4.30	10.98
4.40	10.84	4.43	10.79	4.50	10.77	4.40	10.96	4.43	10.93	4.50	10.94
5.00	10.59	5.03	10.55	5.10	10.57	5.00	10.94	5.03	10.91	5.10	10.93
5.20	10.21	5.23	10.20	5.30	10.22	5.20	10.91	5.23	10.87	5.30	10.85
5.40	......	5.43	......	5.50	......	5.40	10.70	5.43	10.66	5.50	10.67
6.00	......	6.03	......	6.10	......	6.00	10.24	6.03	10.25	6.10	10.28
6.20	......	6.23	......	6.30	......	6.20	9.82	6.23	9.85	6.30	9.97
*8.45	5.31	*8.49	5.32	*8.55	5.37	*9.40	5.75	*9.44	5.77	*9.49	5.81

Sunday, September 29, A. M.*						Sunday, September 29, P. M.*					
3.14	12.46	3.20	12.40	3.27	12.23	4.03	11.25	4.10	11.18	4.15	11.14
10.13	5.00	10.16	5.00	10.20	5.03	10.27	6.09	10.33	6.09	10.40	6.10

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 30.						_Tuesday, October 1._					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING.
A. M.										A. M.	
		A. M.		A. M.		A. M.		A. M.		_*0.03_	_6.09_
_*3.48_	_11.85_	_*3.52_	_11.82_	_*4.00_	_11.75_	_*4.44_	_11.40_	_*4.49_	_11.37_	_*4.56_	_11.27_
5.40	9.76	5.43	9.82	5.50	10.08	5.40	10.38	5.43	10.42	5.50	10.57
6.00	9.62	6.03	9.66	6.10	9.78	6.00	10.09	6.03	10.12	6.10	10.27
6.20	9.51	6.23	9.53	6 30	9.62	6.20	9.80	6.23	9.84	6.30	9.95
6.40	9.41	6.43	9.42	6.50	9.46	6.40	9.56	6.43	9.62	6.50	9.73
7.00	9.33	7.03	9.35	7.10	9.31	7.00	9.39	7.03	9.43	7.10	9.57
7.20	9.08	7.23	9.10	7.30	9.16	7.20	9.23	7.23	9.24	7.30	9.30
7.40	8.84	7.43	8.83	7.50	8.85	7.40	9.11	7.43	9.10	7.50	9.14
8.00	8.46	8.03	8.52	8.10	8.58	8.00	9.06	8.03	9.01	8.10	9.01
8.20	8.14	8.23	8.19	8.30	8.26	8.20	8.74	8.23	8.73	8.30	8.74
8.40	7.58	8.43	7.66	8.50	7.77	8.40	8.55	8.43	8 54	8.50	8.53
9.00	7.13	9.03	7.23	9.10	7.36	9.00	8.09	9.03	8.12	9.10	8.16
9.20	6.66	9.23	6.77	9.30	6.88	9.20	7.80	9.23	7.87	9.30	7.92
9.40	6.16	9.43	6.27	9.50	6.35	9.40	7.50	9.43	7.50	9.50	7.53
10 00	5.55	10.03	5.78	10.10	5.88	10.00	7.13	10.03	7.18	10.10	7.20
10.20	5.36	10.23	5.41	10.30	5.50	10.20	6.78	10.23	6.80	10.30	6.81
_10.40_	_5.27_	10.43	5.30	10.50	5.35	10.40	6.35	10.43	6.41	10.50	6.47
_11.00_	_5.27_	_11.03_	_5.25_	_11.10_	_5.24_	11.00	6.14	11.03	6.19	11.10	6.18
11.20	5.34	11.23	5.31	11.30	5.31	11.20	5.91	11.23	5.94	11.30	5.94
11.40	5.56	11.43	5.55	11.50	5.56	11.40	5.84	11.43	5.84	11.50	5.81
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	5.92	12.03	5.94	12.10	5.89	_12.00_	_5.70_	_12.03_	_5.69_	_12.10_	_5.70_
12.20	6.37	12.23	6.34	12.30	6.28	12.20	5.75	12.23	5.76	12.30	5.78
12.40	6.89	12.43	6.84	12.50	6.71	12.40	5.93	12.43	5.92	12.50	5.92
1.00	7.25	1.03	7.24	1.10	7.05	1.00	6.15	1.03	6.14	1.10	6.12
1.20	7.79	1.23	7.70	1.30	7.63	1.20	6.55	1.23	6.53	1.30	6.50
1.40	8.50	1.43	8.35	1.50	8.09	1.40	6.98	1.43	6.94	1.50	6.88
2.00	9.00	2.03	8.85	2.10	8.56	2.00	7.42	2.03	7.36	2.10	7.27
2.20	9.50	2 23	9.35	2.30	9.08	2.20	7.87	2.23	7.81	2.30	7.72
2.40	10.00	2.43	9.85	2.50	9.48	2.40	8.33	2.43	8.27	2.50	8.15
3.00	10.40	3.03	10.28	3.10	9.92	3.00	8.65	3.03	8.59	3.10	8.42
3.20	10.69	3.23	10.59	3.30	10.25	3.20	9.11	3.23	9.04	3.30	8.90
3.40	11.05	3.43	10.96	3.50	10.63	3.40	9.57	3.43	9.50	3.50	9.33
_4.00_	_11.24_	_4.03_	_11.11_	4.10	10.88	4.00	9.90	4.03	9.83	4.10	9.66
4.20	11.09	4.23	11.01	_4.30_	_10.90_	4.20	10.29	4.23	10.19	4.30	9.96
4.40	10.77	4.43	10.76	4.50	10.70	4.40	10.43	4.43	10.35	4.50	10.18
5.00	10.51	5.03	10.50	5.10	10.50	_5.00_	_10.49_	_5.03_	_10.43_	5.10	10.31
5.20	10.22	5.23	10.20	5.30	10.25	5.20	10.39	5.23	10.34	_5.30_	_10.35_
5.40	9.92	5.43	9.94	5.50	10.05	5.40	10.25	5.43	10.20	5.50	10.23
6.00	9.78	6.03	9.78	6.10	9.87	6.00	10.05	6.03	10.02	6.10	10.08
6.20	9.77	6.23	9.77	6.30	.....	6.20	.....	6.23	.....	6.30	......
_*11.50_	_6.04_	_*11.56_	_6.05_								

Error of float 0.04 subtractive.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, October 2.						*Thursday, October 3.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*0.33	*6.35*	*0.39	*6.37*	*0.45	*6.40*	*1.30	*6.70*	*1.35	*6.71*	*1.40	*6.75*
*5.50	*10.80*	*5.55	*10.75*	*6.03	*10.72*	5.20	10.09	5.23	10.01	5.30	9.91
						5.40	10.18	5.43	10.15	5.50	10.10
						6 00	10.23	6.03	10.21	6.10	10.21
6.20	10.41	6.23	10.40	6.30	10.39	6.20	10.27	*6.23*	*10.28*	*6.30*	*10.30*
6.40	10.08	6.43	10.11	6.50	10.20	*6.40*	*10.30*	*6.43*	*10.28*	6.50	10.28
7.00	9.85	7.03	9.89	7.10	9.97	7.00	10.27	7.03	10.26	7.10	10.25
7.20	9.58	7.23	9.61	7.30	9.69	7.20	......	7.23	......	7.30	.....
7.40	9.33	7.43	9.37	7.50	9.44	7.40	......	7.43	......	7.50	.....
8.00	9.19	8.03	9.21	8.10	9.25	8.00	......	8.03	......	8.10	.....
8.20	9.02	8.23	9.02	8.30	9.03	8.20	......	8.23	......	8.30	.....
8.40	8.85	8.43	8.84	8.50	8.85	8.40	......	8.43	......	8.50	.....
9.00	8.75	9.03	8.75	9.10	8.76	9.00	9.35	9.03	9.29	9.10	9.28
9.20	8.72	9.23	8.71	9.30	8.70	9.20	9.32	9.23	9.26	9.30	9.25
9.40	8.67	9.43	8.62	9.50	8.61	9.40	9.21	9.43	9.21	9.50	9.20
10.00	8.54	10.03	8.49	10.10	8.49	10.00	9.20	10.03	9.17	10.10	9.15
10.20	8.18	10.23	8.20	10.30	8 19	10.20	9.10	10.23	9.08	10.30	9.09
10.40	7.92	10.43	7.96	10.50	7.97	10.40	9.00	10.43	8.98	10.50	8.99
11.00	7.64	11.03	7.69	11.10	7.71	11.00	8.84	11.03	8.81	11.10	8.83
11.20	7.26	11.23	7.32	11.30	7.37	11.20	8.64	11.23	8.65	11.30	8.64
11.40	6.95	11.43	6.99	11.50	7.02	11.40	8.39	11.43	8.39	11.50	8.38
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	6.60	12.03	6.68	12.10	6.70	12.00	8.05	12.03	8.07	12.10	8.08
12.20	6.35	12.23	6.40	12.30	6.42	12 20	7.60	12.23	7.65	12.30	7.69
12.40	6.21	12.43	6.22	12.50	6.24	12.40	7.11	12.43	7.22	12.50	7.30
1.00	6.06	1.03	6.04	*1.10*	*6.04*	1.00	6.83	1.03	6.92	1.10	6 97
1.20	*6.05*	*1.23*	*6.02*	1.30	6.06	1.20	6.54	1.23	6.60	1.30	6.63
1.40	6.14	1.43	6.10	1.50	6.10	1.40	6.38	1.43	6.40	1.50	6.42
2.00	6.34	2.03	6.33	2.10	6.35	*2.00*	*6.25*	*2.03*	*6.24*	*2.10*	*6.24*
2.20	6.69	2.23	6.66	2.30	6.63	2.20	6.26	*2.23*	*6.24*	2.30	6.27
2.40	7.12	2.43	7.07	2.50	7.00	2.40	6.40	2.43	6.38	2.50	6.39
3.00	7.57	3.03	7.50	3.10	7.39	3.00	6.65	3.03	6.63	3.10	6.63
3.20	8.00	3.23	7.92	3.30	7.80	3.20	7.00	3.23	6.98	3.30	6.95
3.40	8.36	3.43	8.35	3.50	8.20	3 40	7.35	3.43	7.32	3.50	7.27
4.00	8.73	4.03	8.81	4.10	8.57	4.00	7.77	4.03	7.73	4.10	7.63
4.20	9.19	4.23	9.12	4.30	8.94	4.20	8.15	4.23	8.09	4.30	7.97
4.40	9.51	4.43	9.42	4.50	9.26	4.40	8.47	4.43	8.44	4.50	8.31
5.00	9.83	5.03	9.78	5.10	9.58	5.00	8.80	5.03	8.74	5.10	8.62
5.20	10.02	5.23	9.96	5.30	9.80	5.20	9.06	5.23	9.02	5.30	8.92
5.40	*10.11*	5.43	10.06	5.50	9.97	5.40	9.31	5.43	9.28	5.50	9 19
6.00	10.09	*6.03*	*10.08*	*6.10*	*10.05*	6.00	9.50	6.03	9.45	6.10	9.37
6.20	10.03	6.23	10.01	6.30	10.02	6.20	9.63	6.23	9.59	6.30	9.56
						*7.10	*9.81*	*7.16	*9.75*	*7.21	*9.73*

Error of float 0.04 subtractive.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, October 4.						*Saturday, October 5.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
_*2.25_	_6.61_	_*2.30_	_6.63_	_*2.35_	_6.65_	_*3.39_	_7.14_	_*3.44_	_7.14_	_*3.50_	_7.18_
5.40	......	5.43	.....	5.50	9.27	5.40	......	5.43	......	5.50	8.48
6.00	9.66	6.03	9.62	6.10	9.55	6.00	8.79	6.03	8.76	6.10	8.68
6.20	9.89	6.23	9.90	6.30	9.78	6.20	9.02	6.23	9.02	6.30	8.97
6.40	10.10	6.43	10.05	6.50	9.99	6.40	9.31	6.43	9.29	6.50	9.20
7.00	10.20	7.03	10.13	7.10	10.12	7.00	9.48	7.03	9.45	7.10	9.40
_7.20_	_10.30_	_7.23_	_10.18_	7.30	10.17	7.20	9.64	7.23	9.60	7.30	9.62
7.40	10.19	7.43	10.15	_7.50_	_10.19_	7.40	9.85	7.43	9.80	7.50	9.80
8.00	10.13	8.03	10.11	8.10	10.15	8.00	10.00	8.03	9.94	8.10	9.93
8.20	10.05	8.23	10.05	8.30	10.07	8.20	10.11	8.23	10.10	8.30	10.08
8.40	10.00	8.43	9.99	8.50	9.98	_8.40_	_10.28_	_8.43_	_10.23_	8.50	10.21
9.00	9.77	9.03	9.75	9.10	9.75	9.00	10.27	_9.03_	_10.23_	_9.10_	_10.22_
9.20	9.53	9.23	9.57	9.30	9.58	9.20	10.24	9.23	10.21	_9.30_	_10.22_
9.40	9.35	9.43	9.37	9.50	9.39	9.40	10.20	9.43	10.18	9.50	10.17
10.00	9.13	10.03	9.10	10.10	9.19	10.00	10.05	10.03	10.05	10.10	10.07
10.20	9.13	10.23	9.10	10.30	9.12	10.20	10.00	10.23	10.02	10.30	10.04
10.40	9.12	10.43	9.10	10.50	9.11	10.40	9.90	10.43	9.92	10.50	9.90
11.00	9.15	11.03	9.11	11.10	9.11	11.00	9.71	11.03	9.72	11.10	9.73
11.20	9.10	11.23	9.10	11.30	9.10	11.20	9.59	11.23	9.59	11.30	9.62
11.40	9.10	11.43	9.11	11.50	9.14	11.40	9.40	11.43	9.40	11.50	9.40
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	9.00	12.03	8.97	12.10	8.96	12.00	9.30	12.03	9.30	12.10	9.32
12.20	8.75	12.23	8.76	12.30	8.80	12.20	9.22	12.23	9.20	12.30	9.18
12.40	8.55	12.43	8.60	12.50	8.61	12.40	9.09	12.43	9.07	12.50	9.06
1.00	8.20	1.03	8.23	1.10	8.27	1.00	8.82	1.03	8.83	1.10	8.82
1.20	7.86	1.23	7.91	1.30	7.97	1.20	8.45	1.23	8.48	1.30	8.53
1.40	7.47	1.43	7.51	1.50	7.55	1.40	8.26	1.43	8.29	1.50	8.30
2.00	7.08	2.03	7.16	2.10	7.20	2.00	7.87	2.03	7.90	2.10	7.90
2.20	6.87	2.23	6.95	2.30	6.96	2.20	7.55	2.23	7.62	2.30	7.65
2.40	6.70	2.43	6.71	2.50	6.71	2.40	7.20	2.43	7.27	2.50	7.29
3.00	6.55	3.03	6.54	3.10	6.56	3.00	6.89	3.03	6.95	3.10	6.98
_3.20_	_6.46_	_3.23_	_6.45_	_3.30_	_6.47_	3.20	6.65	3.23	6.70	3.30	6.70
3.40	6.55	3.43	6.54	3.50	6.58	_3.40_	_6.54_	3.43	6.58	3.50	6.58
4.00	6.72	4.03	6.73	4.10	6.71	4.00	6.56	_4.03_	_6.55_	_4.10_	_6.52_
4.20	7.01	4.23	6.98	4.30	7.00	4.20	6.58	4.23	6.58	4.30	6.64
4.40	7.32	4.43	7.30	4.50	7.28	4.40	6.75	4.43	6.73	4.50	6.75
5.00	7.66	5.03	7.64	5.10	7.61	5.00	6.92	5.03	6.95	5.10	6.97
5.20	8.00	5.23	7.96	5.30	7.92	5.20	7.19	5.23	7.16	5.30	7.18
5.40	8.32	5.43	8.28	5.50	8.20	5.40	7.35	5.43	7.35	5.50	7.40
6.00	8.66	6.03	8.51	6.10	8.46	6.00	7.67	6.03	7.65	6.10	7.65
6.20	8.82	6.23	8.78	6.30	8.74	6.20	......	6.23	......	6.30	.....
_*8.20_	_10.09_	_*8.27_	_10.05_	_*8.35_	_10.02_	_*10.16_	_9.87_	_*10.23_	_9.81_	_*10.28_	_9.77_

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

*Sunday, October 6, A. M.**						*Sunday, October 6, P. M.**					
Box No. 1.		Box No. 2.		Box No. 3.		Box No 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
4.40	*6.55*	*4.45*	*6.55*	*4.50*	*6.50*	*5.20*	*6.56*	*5.25*	*5.57*	*5.30*	*6.61*
11.18	*10.28*	*11.23*	*10.24*	*11.28*	*10.20*	*11.05*	*10.35*	*11.10*	*10.32*	*11.15*	*10.30*

Monday, October 7.					
A. M.		A. M.		A. M.	
*5.30	*6.56*	*5.35	*6.58*	*5.40	*6.60*
6.00	6.70	6.03	6.67	6.10	6.70
6.20	6.94	6.23	6.93	6.30	6.95
6.40	7.21	6.43	7.18	6.50	7.16
7.00	7.45	7.03	7.45	7.10	7.46
7.20	7.90	7.23	7.86	7.30	7.82
7.40	8.25	7.43	8.22	7.50	8.10
8.00	8.60	8.03	8.58	8.10	8.45
8.20	8.92	8.23	8.92	8.30	8.80
8.40	9.27	8.43	9.24	8.50	9.10
9.00	9.57	9.03	9.54	9.10	9.42
9.20	9.89	9.23	9.83	9.30	9.70
9.40	10.04	9.43	10.02	9.50	9.93
10.00	10.28	10.03	10.25	10.10	10.17
10.20	10.48	10.23	10.45	10.30	10.87
10.40	10.54	10.43	10.51	10.50	10.47
11.00	*10.62*	*11.03*	*10.60*	*11.10*	*10.60*
11.20	10.61	11.23	10.58	11.30	10.56
11.40	10.43	11.43	10.40	11.50	10.43

THE FOLLOWING OBSERVATIONS WERE RECORDED BY GEN. G. K. WARREN, U S. ENGINEERS, IN HIS REPORT OF 1874.

Record of Tide-gauge kept at Hill's Wharf, Providence, by the City Water Works, from May 22 to December 28, 1873

[The observations were taken with a self-registering tide-gauge furnished by the United States Coast Survey.]

DATE.	Number of high water.	Total high water.	Number of low water.	Total low water.	NOTES.
May 22 to 31, 1873	17	139.51	18	57.86	
June 1 to 30, 1873	56	451.58	55	200.46	
July 1 to 31, 1873	60	486.23	60	216.95	
August 1 to 31, 1873	56	442.51	56	191.96	Two days lost.
September 1 to 30, 1873	58	467.20	58	197.97	
October 1 to 31, 1873	60	497.95	60	215.83	
November 1 to 30, 1873	58	455.23	58	192.59	
December 1 to 28, 1873	48	375.74	49	167.76	Four days lost.
	413	3,315.95	414	1,441.38	

1441.38 ÷ 414 = 3.481, mean low water.
3315.95 ÷ 413 = 8.029, mean high water.
8.029 — 3.481 = 4.548, mean rise and fall of tide.

Record of Tide-gauge kept at Bishop's Point, Pawtucket River, Rhode Island, in October and November, 1872.

DATE.	High water.	Low water.	DATE.	High water.	Low water.
October 13	7.6	1.1	October 28	6.8	2.0
14	7.6	1.4	29	5.8	2.0
15	6.9	1.6	30	6.8	2.2
16	7.7	1.8	31	7.7	1.9
17	7.7	1.6	November 1	7.9	2.0
18	7.7	1.5	2	7.0	1.8
19	7.0	1.6	3	7.8	1.8
20	7.0	1.6	4	7.5	1.8
21	6.5	2.0	5	7.2	1.7
22	5.9	2.1	6	7.7	1.7
23	5.6	2.2	7	7.2	2.7
24	5.6	1.6	8	6.6	1.8
25	5.7	1.9	9	6.0	1.8
26	5.8	1.7	10	6.7	2.0
27	5.9	1.6			

Whole number of days observations were made, 29. Mean high water, 6.85 on gauge; mean low water, 1.81 on gauge; mean rise and fall, 5.04 feet. Lowest tide below mean low water, 0.71 feet; highest tide above mean high water, 1.05 feet.

Record of Tide-gauge kept at Butler Hospital Wharf, Pawtucket River, Rhode Island, in April and May, 1873.

DATE.	High water.	Low water.	DATE.	High water.	Low water.
April 22	5.5	1.0	May 6	4.6	0.9
23	5.7	0.5	7	4.9	1.1
24	6.2	0.8	8	5.0	0.8
25	5.7	0.1	9	5.25	0.8
26	5.6	0.0	10	4.9	1.1
27	5.6	0.1	11	5.3	0.6
28	5.8	0.05	12	5.5	0.8
29	5.5	0.4	13	5.6	1.1
30	5.4	0.1	14	4.8	0.8
May 1	4.2	0.3	15	5.4	0.9
2	4.5	0.9	16	5.1	0.85
3	4.8	1.0	17	5.2	1.0
4	4.8	0.7	18	4.6	1.8
5	4.1	0.6	19	4.7	0.7

Eng 1010.3

State of Rhode Island and Providence Plantations.

FOURTH ANNUAL REPORT

OF THE

Harbor Commissioners,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1880.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1880.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 23.						*Tuesday, September 24.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
Time.	Reading.	Time.	Read'g.	Time.	Read'g.	Time.	Reading	Time.	Reading.	Time.	Read'g.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**5.05*	*6.50*	**5.10*	*6.51*	**5.16*	*6.53*						
5.20	6.55	5.23	6.54	5.30	6.60	5 20	......	5.23	......	5.30	6.21
5.40	6.80	5.43	6.80	5.50	6.83	*5.40*	*6.02*	*5.43*	*6.02*	*5.50*	*6.04*
6.00	7.21	6.03	7.17	6.10	7.17	6.00	6.06	*6.03*	*6.02*	6.10	6.06
6.20	7.63	6.23	7.57	6.30	7.52	6.20	6.19	6.23	6.18	6.30	6.22
6.40	8.10	6.43	8.02	6.50	7.93	6.40	6.51	6.43	6.48	6.50	6.50
7.00	8.45	7.03	8.38	7.10	8.27	7.00	6.84	7.03	6.80	7.10	6.81
7.20	8.80	7.23	8.75	7.30	8 64	7.20	7.27	7.23	7.23	7.30	7.18
7.40	9.16	7.43	9.09	7.50	8.99	7.40	7.59	7.43	7.54	7.50	7.56
8.00	9.51	8.03	9.45	8.10	9.35	8.00	8.05	8.03	8.00	8.10	7.91
8.20	9.88	8.23	9.80	8.30	9.70	8.20	8.48	8.23	8.40	8.30	8 26
8.40	10.10	8.43	10.05	8.50	9.92	8.40	8.88	8.43	8.82	8.50	8.64
9.00	10.38	9.03	10.34	9.10	10.23	9.00	9.30	9.03	9.20	9.10	9.00
9.20	10.62	9.23	10.56	9.30	10.48	9.20	9.58	9.23	9.50	9.30	9.37
9.40	10.81	9.43	10.76	9.50	10.71	9.40	10.00	9.43	9.94	9.50	9.74
10.00	11.01	10.03	10.97	10.10	10.90	10.00	10.32	10.03	10.22	10.10	10.10
10.20	*11.07*	*10.23*	*11.02*	10.30	10.97	10.20	10.67	10.23	10.58	10.30	10 40
10.40	11.00	10.43	10.97	*10.50*	*10.98*	10.40	10.94	10.43	10.87	10.50	10.66
11.00	10.95	11.03	10.98	11.10	10.93	11.00	11.14	11.03	11.10	11.10	10.95
11.20	10.74	11.23	10.71	11.30	10.75	11.20	11.42	11.23	11.36	11.30	11.22
11.40	10.48	11.43	10.45	11.50	10.52	*11.40*	*11.47*	*11.43*	*11.42*	*11.50*	*11.30*
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.12	12.03	10.18	12.10	10.26	12.00	11.23	12.03	11.15	12.10	11.12
12.20	9.96	12.23	9.99	12.30	10.05	12.20	10.86	12.23	10.84	12.30	10.88
12.40	9.81	12.43	9.84	12.50	9.89	12.40	10.52	12.43	10.52	12.50	10.62
1.00	9.70	1.03	9.68	1.10	9.71	1.00	10.31	1.03	10.31	1.10	10.41
1.20	9.49	1.23	9.49	1.30	9.49	1.20	10.10	1.23	10.09	1.30	10.13
1.40	9.29	1.43	9.26	1.50	9.29	1.40	9.81	1.43	9.77	1.50	9.85
2.00	9.07	2.03	9.05	2.10	9.05	2.00	9.59	2.03	9.57	2.10	9.64
2.20	8.85	2.23	8.80	2.30	8.80	2.20	9.29	2.23	9.29	2 30	9.37
2.40	8.47	2.43	8.47	2.50	8.49	2.40	9.05	2.43	9.05	2.50	9.10
3.00	8.17	3.03	8.17	3.10	8.20	3.00	8.75	3.03	8.76	3.10	8.76
3.20	7.82	3.23	7.82	3.30	7.86	3.20	8.32	3.23	8.33	3.30	8.36
3.40	7.46	3.43	7.49	3.50	7.50	3.40	7.95	3.43	7.99	3.50	8.05
4.00	7.08	4.03	7.15	4.10	7.17	4.00	7.41	4.03	7.43	4.10	7.62
4.20	6.65	4.23	6.59	4.30	6.72	4.20	6.88	4.23	6.92	4.30	7.10
4.40	6.33	4.43	6.39	4.50	6.44	4.40	6.50	4.43	6.58	4.50	6.75
5.00	6.18	5.03	6.20	5.10	6.21	5.00	6.15	5.03	6.25	5.10	6.25
5.20	6.14	5.23	6.11	5.30	6.12	5.20	5.75	5.23	5.80	5.30	5.87
5.40	*6.13*	*5.43*	*6.10*	*5.50*	*6.11*	5.40	5.53	5.43	5.54	5.50	5.58
6.00	6.19	6.03	6.19	6.10	6.26	6.00	5.50	6.03	5.49	*6.10*	*5.47*
6.20	6.45	6.23	6.48	6.30	6.54	*6.25*	*5.48*	*6.28*	*5.48*	*6.40*	*5.47*
6.40	......	6.43	.....	6.50	.....						
**11.33*	*10.94*	**11.38*	*10.94*	**11.45*	*10.89*						

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, September 25.						*Thursday, September 26.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**0.00*	*11.17*	**0.04*	*11.14*	**0.10*	*11.10*	**0.39*	*11.65*	**0.43*	*11.63*	**0.50*	*11.53*
5.20	6.21	5.23	6.39	5.30	6.53	5.20	......	5.23	......	5.30	7.45
5.40	5.80	5.43	5.97	5.50	6.10	5.40	6.46	5.43	6.68	5.50	6.94
6.00	5.56	6.03	5.65	6.10	5.72	6.00	5.83	6.03	6.10	6.10	6.34
6.20	5.44	6.23	5.48	6.30	5.50	6.20	5.29	6.23	5.55	6.30	5.75
6.40	*5.36*	*6.43*	*5.35*	*6.50*	*5.39*	6.40	4.86	6.43	5.07	6.50	5.24
7.00	5.50	7.03	5.49	7.10	5.51	7.00	4.56	7.03	4.70	7.10	4.80
7.20	5.75	7.23	5.72	7.30	5.73	*7.20*	*4.50*	7.23	4 54	7.30	4.58
7.40	6.15	7.43	6.12	7.50	6.11	7.40	4.57	*7.43*	*4.50*	*7.50*	*4 55*
8.00	6.60	8.03	6.55	8.10	6.47	8.00	4.72	8.03	4.70	8.10	4.71
8.20	7.00	8.23	6.94	8.30	6.86	8.20	5.10	8.23	5.07	8.30	5.10
8.40	7.44	8.43	7.36	8.50	7.25	8.40	5.50	8.43	5.44	8.50	5.41
9.00	7.92	9.03	7.84	9.10	7.70	9.00	5.95	9.03	5.89	9.10	5.82
9.20	8.37	9.23	8.30	9.30	8.12	9.20	6.40	9.23	6.35	9.30	6.26
9.40	8.87	9.43	8.81	9.50	8.58	9.40	6.82	9.43	6.77	9.50	6.70
10.00	9.45	10.03	9.32	10.10	9.04	10.00	......	10.03	......	10.10	7.24
10.20	9.94	10.23	9.84	10.30	9.50	10.20	8.20	10.23	8.08	10.30	.....
10.40	10.43	10.43	10.32	10.50	9.94	10.40	8.75	10.43	8.61	10.50	8.38
11.00	10.97	11.03	10.80	11.10	10.42	11.00	9.35	11.03	9.25	11.10	8.82
11.20	11.32	11.23	11.15	11.30	10.79	11.20	9.87	11.23	9.70	11.30	9.30
11.40	11.58	11.43	11.50	11.50	11.17	11.40	10.33	11.43	10.25	11.50	9.76
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	11.88	12.03	11.80	12.10	11.49	12.00	......	12.03	......	12.10	.....
12.20	*11.97*	*12.23*	*11.89*	12.30	11.71	12.20	11.13	12.23	11.05	12.30	10.60
12.40	11.87	12.43	11.80	*12.50*	*11.72*	12.40	11.37	12.43	11.28	12.50	10.95
1.00	11.60	1.03	11.55	1.10	11.52	*1.00*	*11.53*	*1.03*	*11.43*	1.10	11.19
1.20	11.26	1.23	11.22	1.30	11.28	1.20	11.41	1.23	11.32	*1.30*	*11.20*
1.40	10.95	1.43	10.91	1.50	10.98	1.40	11.05	1.43	11.10	1.50	11.05
2.00	10.63	2.03	10.62	2.10	10.72	2.00	10.74	2.03	10.72	2.10	10.77
2.20	10.35	2.23	10.36	2.30	10.39	2.20	10.32	2.23	10.30	2.30	10.53
2.40	10.09	2.43	10.10	2.50	10.15	2.40	10.17	2.43	10.18	2.50	10.30
3.00	9.85	3.03	9.86	3.10	10.10	3.00	10.12	3.03	10.14	3.10	10.18
3.20	9.62	3.23	9.63	3.30	9.74	3.20	10.01	3.23	10.02	3.30	10.09
3.40	9.21	3.43	9.25	3.50	9.32	3.40	9.90	3.43	9.87	3.50	9.90
4.00	8.79	4.03	8.84	4.10	8.90	4.00	9.70	4.03	9.70	4.10	9.68
4.20	8.34	4.23	8.41	4.30	8.48	4.20	9.41	4.23	9.39	4.30	9.37
4.40	7.85	4.43	7.93	4.50	8.04	4.40	9.00	4.43	9.00	4.50	8.95
5.00	7.32	5.03	7.42	5.10	7.59	5.00	8.57	5.03	8.60	5.10	8.63
5.20	6.71	5.23	6.81	5.30	6.97	5.20	8.08	5.23	8.11	5.30	8.25
5.40	6.25	5.43	6.35	5.50	6.49	5.40	7.45	5.43	7.49	5.50	7.60
6.00	5.75	6.03	5.85	6.10	5.99	6.00	6.85	6.03	7.00	6.10	7.20
6.20	5.42	6.23	5.60	6.30	5.65	**8.06*	*5.00*	**8.11*	*5.01*	**8.20*	*5.05*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, September 27.						Saturday, September 28.					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
*1.40	12.40	*1.50	12.25	*1.55	12.15						
5.40	8.85	5.43	9.06	5.50	9.00	*2.25	12.56	*2.31	12.52	*2.37	12.36
6.00	8.25	6.03	8.41	6.10	8.50						
6.20	7.49	6.23	7.67	6.30	7.92						
6.40	6.81	6.43	7.03	6.50	7.31						
7.00	6.25	7.03	6.35	7.10	6.63						
7.20	5.84	7.23	6.00	7.30	6.17						
7.40	5.47	7.43	5.65	7.50	5.75						
8.00	5.17	8.03	5.30	8.10	5.35	8.00	6.05	8.03	6.21	8.10	6.40
8.20	5.17	8.23	5.18	8.30	5.19	8.20	5.59	8.23	5.70	8.30	5.85
8.40	5.21	8.43	5.17	8.50	5.17	8.40	5.20	8.43	5.35	8.50	5.44
9.00	5.44	9.03	5.42	9.10	5.40	9.00	5.01	9.03	5.07	9.10	5.10
9.20	5.86	9.23	5.86	9.30	5.77	9.20	5.02	9.23	5.01	9.30	4.99
9.40	6.41	9.43	6.32	9.50	6.22	9.40	5.01	9.43	5.01	9.50	5.00
10.00	6.88	10.03	6.80	10.10	6.66	10.00	5.21	10.03	5.21	10.10	5.20
10.20	7.36	10.23	7.28	10.30	7.03	10.20	5.49	10.23	5.51	10.30	5.55
10.40	7.91	10.43	7.81	10.50	7.60	10.40	5.94	10.43	5.94	10.50	5.93
11.00	8.41	11.03	8.36	11.10	8.03	11.00	6.59	11.03	6.58	11.10	6.43
11.20	8.97	11.23	8.85	11.30	8.60	11.20	7.12	11.23	7.00	11.30	6.85
11.40	9.64	11.43	9.52	11.50	9.14	11.40	7.75	11.43	7.65	11.50	7.40
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	10.26	12.03	10.16	12.10	9.66	12.00	8.41	12.03	8.30	12.10	7.92
12.20	10.75	12.23	10.58	12.30	10.10	12.20	9.04	12.23	8.80	12.30	8.52
12.40	11.29	12.43	11.15	12.50	10.55	12.40	9.67	12.43	9.47	12.50	9.01
1.00	11.64	1.03	11.50	1.10	11.00	1.00	10.26	1.03	10.10	1.10	9.59
1.20	11.90	1.23	11.80	1.30	11.36	1.20	10.78	1.23	10.58	1.30	10.09
1.40	12.01	1.43	11.89	1.50	11.60	1.40	11.30	1.43	11.07	1.50	10.59
2.00	11.98	2.03	11.90	2.10	11.73	2.00	11.65	2.03	11.53	2.10	10.99
2.20	11.75	2.23	11.65	2.30	11.58	2.20	11.89	2.23	11.72	2.30	11.34
2.40	11.24	2.43	11.22	2.50	11.23	2.40	11.89	2.43	11.80	2.50	11.52
3.00	10.96	3.03	......	3.10	......	3.00	11.76	3.03	11.67	3.10	11.55
3.20	10.80	3.23	10.80	3.30	10.89	3.20	11.41	3.23	11.36	3.30	11.32
3.40	10.86	3.43	10.83	3.50	10.87	3.40	11.15	3.43	11.16	3.50	11.19
4.00	10.90	4.03	10.85	4.10	10.88	4.00	11.03	4.03	11.01	4.10	11.06
4.20	10.90	4.23	10.89	4.30	10.87	4.20	10.95	4.23	10.94	4.30	10.98
4.40	10.84	4.43	10.79	4.50	10.77	4.40	10.96	4.43	10.93	4.50	10.94
5.00	10.59	5.03	10.55	5.10	10.57	5.00	10.94	5.03	10.91	5.10	10.93
5.20	10.21	5.23	10.20	5.30	10.22	5.20	10.91	5.23	10.87	5.30	10.85
5.40	......	5.43	......	5.50	......	5.40	10.70	5.43	10.66	5.50	10.67
6.00	......	6.03	......	6.10	......	6.00	10.24	6.03	10.25	6.10	10.28
6.20	......	6.23	......	6.30	......	6.20	9.82	6.23	9.85	6.30	9.97
*8.45	5.31	*8.49	5.32	*8.55	5.37	*9.40	5.75	*9.44	5.77	*9.49	5.81

Sunday, September 29, A. M.*						Sunday, September 29, P. M.*					
3.14	12.46	3.20	12.40	3.27	12.23	4.03	11.25	4.10	11.18	4.15	11.14
10.13	5.00	10.16	5.00	10.20	5.03	10.27	6.09	10.33	6.09	10.40	6.10

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Monday, September 30.						*Tuesday, October 1.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G	TIME.	READ'G.	TIME.	READ'G.	TIME.	READING.
A. M.										A. M.	
		A. M.		A. M.		A. M.		A. M.		**0.03*	*6.09*
**3.48*	*11.85*	**3.52*	*11.82*	**4.00*	*11.75*	**4.44*	*11.40*	**4.49*	*11.37*	**4.56*	*11.27*
5.40	9.76	5.43	9.82	5.50	10.08	5.40	10.38	5.43	10.42	5.50	10.57
6.00	9.62	6.03	9.66	6.10	9.78	6.00	10.09	6.03	10.12	6.10	10.27
6.20	9.51	6.23	9.53	6 30	9.62	6.20	9.80	6.23	9.84	6.30	9.95
6.40	9.41	6.43	9.42	6.50	9 46	6.40	9.56	6.43	9.62	6.50	9.73
7.00	9.33	7.03	9.35	7.10	9.31	7.00	9.39	7.03	9.43	7.10	9.57
7.20	9.08	7.23	9.10	7.30	9.16	7.20	9.23	7.23	9.24	7.30	9.30
7.40	8.84	7.43	8.83	7.50	8.85	7.40	9.11	7.43	9.10	7.50	9.14
8.00	8.46	8.03	8.52	8.10	8.58	8.00	9.06	8.03	9.01	8.10	9.01
8.20	8.14	8.23	8.19	8.30	8.26	8.20	8.74	8.23	8.73	8.30	8.74
8.40	7.58	8.43	7.66	8.50	7.77	8.40	8.55	8.43	8 54	8.50	8.53
9.00	7.13	9.03	7.23	9.10	7.36	9.00	8.09	9.03	8.12	9.10	8.16
9.20	6.66	9.23	6.77	9.30	6.88	9.20	7.80	9.23	7.87	9.30	7.92
9.40	6.16	9.43	6.27	9.50	6.35	9.40	7.50	9.43	7.50	9.50	7.53
10 00	5.55	10.03	5.78	10.10	5.88	10.00	7.13	10.03	7.18	10.10	7.20
10.20	5.36	10.23	5.41	10.30	5.50	10.20	6.78	10.23	6.80	10.30	6.81
10.40	*5.27*	10.43	5.30	10.50	5.35	10.40	6.35	10.43	6.41	10.50	6.47
11.00	*5.27*	*11.03*	*5.25*	*11.10*	*5.24*	11.00	6.14	11.03	6.19	11.10	6.18
11.20	5.34	11.28	5.31	11.30	5.31	11.20	5.91	11.23	5.94	11.30	5.94
11.40	5.56	11.43	5.55	11.50	5.56	11.40	5.84	11.43	5.84	11.50	5.81
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	5.92	12.03	5.94	12.10	5.89	*12.00*	*5.70*	*12.03*	*5.69*	*12.10*	*5.70*
12.20	6.37	12.23	6.34	12.30	6.28	12.20	5.75	12.23	5.76	12.30	5.78
12.40	6.89	12.43	6.84	12.50	6.71	12.40	5.93	12.43	5.92	12.50	5.92
1.00	7.25	1.03	7.24	1.10	7.05	1.00	6.15	1.03	6.14	1.10	6.12
1.20	7.79	1.23	7.70	1.30	7.63	1.20	6.55	1.23	6.53	1.30	6.50
1.40	8.50	1.43	8.35	1.50	8.09	1.40	6.98	1.43	6.94	1.50	6.88
2.00	9.00	2.03	8.85	2.10	8.56	2.00	7.42	2.03	7.36	2.10	7.27
2.20	9.50	2 23	9.35	2.30	9.08	2.20	7.87	2.23	7.81	2.30	7.72
2.40	10.00	2.43	9.85	2.50	9.48	2.40	8.33	2.43	8.27	2.50	8.15
3.00	10.40	3.03	10.28	3.10	9.92	3.00	8.65	3.03	8.59	3.10	8.42
3.20	10.69	3.28	10.59	3.30	10.25	3.20	9.11	3.23	9.04	3.30	8.90
3.40	11.05	3.43	10.96	3.50	10.63	3.40	9.57	3.43	9.50	3.50	9.33
4.00	*11.24*	*4.03*	*11.11*	4.10	10.88	4.00	9.90	4.03	9.83	4.10	9.66
4.20	11.09	4.23	11.01	*4.30*	*10.90*	4.20	10.29	4.23	10.19	4.30	9.96
4.40	10.77	4.43	10.76	4.50	10.70	4.40	10.43	4.43	10.35	4.50	10.18
5.00	10.51	5.03	10.50	5.10	10.50	*5.00*	*10.49*	*5.03*	*10.43*	5.10	10.31
5.20	10.22	5.23	10.20	5.30	10.25	5.20	10.39	5.23	10.34	*5.30*	*10.35*
5.40	9.92	5.43	9.94	5.50	10.05	5.40	10.25	5.43	10.20	5.50	10.23
6.00	9.78	6.03	9.78	6.10	9.87	6.00	10.05	6.03	10.02	6.10	10.08
6.20	9.77	6.23	9.77	6.30	.....	6.20	.....	6.23	.....	6.30	.....
**11.50*	*6.04*	**11.56*	*6.05*								

Error of float 0.04 subtractive.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Wednesday, October 2.						*Thursday, October 3.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING	TIME.	READING.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**0.33*	*6.35*	**0.39*	*6.37*	**0.45*	*6.40*	**1.30*	*6.70*	**1.35*	*6.71*	**1.40*	*6.75*
**5.50*	*10.80*	**5.55*	*10.75*	**6.03*	*10.72*	5.20	10.09	5.23	10.01	5.30	9.91
						5.40	10.18	5.43	10.15	5.50	10.10
						6 00	10.23	6.03	10.21	6.10	10.21
6.20	10.41	6.23	10.40	6.30	10.39	6.20	10.27	*6.23*	*10.28*	*6.30*	*10.30*
6.40	10.08	6.43	10.11	6.50	10.20	*6.40*	*10.30*	*6.43*	*10.28*	6.50	10.28
7.00	9.85	7.03	9.89	7.10	9.97	7.00	10.27	7.03	10.26	7.10	10.25
7.20	9.58	7.23	9.61	7.30	9.69	7.20	......	7.23	......	7.30	.....
7.40	9.33	7.43	9.37	7.50	9.44	7.40	......	7.43	......	7.50	.....
8.00	9.19	8.03	9.21	8.10	9.25	8.00	......	8.03	......	8.10	.....
8.20	9.02	8.23	9.02	8.30	9.03	8.20	......	8.23	......	8.30	.....
8.40	8.85	8.43	8.84	8.50	8.85	8.40	......	8.43	......	8.50	.....
9.00	8.75	9.03	8.75	9.10	8.76	9.00	9.35	9.03	9.29	9.10	9.28
9.20	8.72	9.23	8.71	9.30	8.70	9.20	9.32	9.23	9.26	9.30	9.25
9.40	8.67	9.43	8.62	9.50	8.61	9.40	9.21	9.43	9.21	9.50	9.20
10.00	8.54	10.03	8.49	10.10	8.49	10.00	9.20	10.03	9.17	10.10	9.15
10.20	8.18	10.23	8.20	10.30	8 19	10.20	9.10	10.23	9.08	10.30	9.09
10.40	7.92	10.43	7.96	10.50	7.97	10.40	9.00	10.43	8.98	10.50	8.99
11.00	7.64	11.03	7.69	11.10	7.71	11.00	8.84	11.03	8.81	11.10	8.83
11.20	7.26	11.23	7.32	11.30	7.37	11.20	8.64	11.23	8.65	11.30	8.64
11.40	6.95	11.43	6.99	11.50	7.02	11.40	8.39	11.43	8.39	11.50	8.38
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	6.60	12.03	6.68	12.10	6.70	12.00	8.05	12.03	8.07	12.10	8.08
12.20	6.35	12.23	6.40	12.30	6.42	12 20	7.60	12.23	7.65	12,30	7.69
12.40	6.21	12.43	6.22	12.50	6.24	12.40	7.11	12.43	7.22	12.50	7.30
1.00	6.06	1.03	6.04	*1.10*	*6.04*	1.00	6.83	1.03	6.92	1.10	6 97
1.20	*6.05*	*1.23*	*6.02*	1.30	6.06	1.20	6.54	1.23	6.60	1.30	6.63
1.40	6.14	1.43	6.10	1.50	6.10	1.40	6.38	1.43	6.40	1.50	6.42
2.00	6.34	2.03	6.33	2.10	6.35	*2.00*	*6.25*	*2.03*	*6.24*	*2.10*	*6.24*
2.20	6.69	2.23	6.66	2.30	6.63	2.20	6.26	*2.23*	*6.24*	2.30	6.27
2.40	7.12	2.43	7.07	2.50	7.00	2.40	6.40	2.43	6.38	2.50	6.39
3.00	7.57	3.03	7.50	3.10	7.39	3.00	6.65	3.03	6.63	3.10	6.63
3.20	8.00	3.23	7.92	3.30	7.80	3.20	7.00	3.23	6.98	3.30	6.95
3.40	8.36	3.43	8.35	3.50	8.20	3 40	7.35	3.43	7.32	3.50	7.27
4.00	8.73	4.03	8.81	4.10	8.57	4.00	7.77	4.03	7.73	4.10	7.63
4.20	9.19	4.23	9.12	4.30	8.94	4.20	8.15	4.23	8.09	4.30	7.97
4.40	9.51	4.43	9.42	4.50	9.26	4.40	8.47	4.43	8.44	4.50	8.31
5.00	9.83	5.03	9.78	5.10	9.58	5.00	8.80	5.03	8.74	5.10	8.62
5.20	10.02	5.23	9.96	5.30	9.80	5.20	9.06	5.23	9.02	5.30	8.92
5.40	*10.11*	5.43	10.06	5.50	9.97	5.40	9.31	5.43	9.28	5.50	9 19
6.00	10.09	*6.03*	*10.08*	*6.10*	*10.05*	6.00	9.50	6.03	9.45	6.10	9.37
6.20	10.03	6.23	10.01	6.30	10.02	6.20	9.63	6.23	9.59	6.30	9.56
						**7.10*	*9.81*	**7.16*	*9.75*	**7.21*	*9.73*

Error of float 0.04 subtractive.

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

Friday, October 4.						*Saturday, October 5.*					
Box No. 1.		Box No. 2.		Box No. 3.		Box No. 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME	READING.	TIME.	READ'G.
A. M.		A. M.		A. M.		A. M.		A. M.		A. M.	
**2.25*	*6.61*	**2.30*	*6.63*	**2.35*	*6.65*	**3.39*	*7.14*	**3.44*	*7.14*	**3.50*	*7.18*
5.40	.....	5.43	.....	5.50	9.27	5.40	.....	5.43	.....	5.50	8.48
6.00	9.66	6.03	9.62	6.10	9.55	6.00	8.79	6.03	8.76	6.10	8.68
6.20	9.89	6.23	9.90	6.30	9.78	6.20	9.02	6.23	9.02	6.30	8.97
6.40	10.10	6.43	10.05	6.50	9.99	6.40	9.31	6.43	9.29	6.50	9.20
7.00	10.20	7.03	10.13	7.10	10.12	7.00	9.48	7.03	9.45	7.10	9.40
7.20	*10.30*	*7.23*	*10.18*	7.30	10.17	7.20	9.64	7.23	9.60	7.30	9.62
7.40	10.19	7.43	10.15	*7.50*	*10.19*	7.40	9.85	7.43	9.80	7.50	9.80
8.00	10.13	8.03	10.11	8.10	10.15	8.00	10.00	8.03	9.94	8.10	9.93
8.20	10.05	8.23	10.05	8.30	10.07	8.20	10.11	8.23	10.10	8.30	10.08
8.40	10.00	8.43	9.99	8.50	9.98	*8.40*	*10.28*	*8.43*	*10.23*	8.50	10.21
9.00	9.77	9.03	9.75	9.10	9.75	9.00	10.27	*9.03*	*10.23*	*9.10*	*10.22*
9.20	9.53	9.23	9.57	9.30	9.58	9.20	10.24	9.23	10.21	*9.30*	*10.22*
9.40	9.35	9.43	9.37	9.50	9.39	9.40	10.20	9.43	10.18	9.50	10.17
10.00	9.13	10.03	9.10	10.10	9.19	10.00	10.05	10.03	10.05	10.10	10.07
10.20	9.13	10.23	9.10	10.30	9.12	10.20	10.00	10.23	10.02	10.30	10.04
10.40	9.12	10.43	9.10	10.50	9.11	10.40	9.90	10.43	9.92	10.50	9.90
11.00	9.15	11.03	9.11	11.10	9.11	11.00	9.71	11.03	9.72	11.10	9.73
11.20	9.10	11.23	9.10	11.30	9.10	11.20	9.59	11.23	9.59	11.30	9.62
11.40	9.10	11.43	9.11	11.50	9.14	11.40	9.40	11.43	9.40	11.50	9.40
P. M.		P. M.		P. M.		P. M.		P. M.		P. M.	
12.00	9.00	12.03	8.97	12.10	8.96	12.00	9.30	12.03	9.30	12.10	9.32
12.20	8.75	12.23	8.76	12.30	8.80	12.20	9.22	12.23	9.20	12.30	9.18
12.40	8.55	12.43	8.60	12.50	8.61	12.40	9.09	12.43	9.07	12.50	9.06
1.00	8.20	1.03	8.23	1.10	8.27	1.00	8.82	1.03	8.83	1.10	8.82
1.20	7.86	1.23	7.91	1.30	7.97	1.20	8.45	1.23	8.48	1.30	8.53
1.40	7.47	1.43	7.51	1.50	7.55	1.40	8.26	1.43	8.29	1.50	8.30
2.00	7.08	2.03	7.16	2.10	7.20	2.00	7.87	2.03	7.90	2.10	7.90
2.20	6.87	2.23	6.95	2.30	6.96	2.20	7.55	2.23	7.62	2.30	7.65
2.40	6.70	2.43	6.71	2.50	6.71	2.40	7.20	2.43	7.27	2.50	7.29
3.00	6.55	3.03	6.54	3.10	6.56	3.00	6.89	3.03	6.95	3.10	6.98
3.20	*6.46*	*3.23*	*6.45*	*3.30*	*6.47*	3.20	6.65	3.23	6.70	3.30	6.70
3.40	6.55	3.43	6.54	3.50	6.58	*3.40*	*6.54*	3.43	6.58	3.50	6.58
4.00	6.72	4.03	6.73	4.10	6.71	4.00	6.56	*4.03*	*6.55*	*4.10*	*6.52*
4.20	7.01	4.23	6.98	4.30	7.00	4.20	6.58	4.23	6.58	4.30	6.64
4.40	7.32	4.43	7.30	4.50	7.28	4.40	6.75	4.43	6.73	4.50	6.75
5.00	7.66	5.03	7.64	5.10	7.61	5.00	6.92	5.03	6.95	5.10	6.97
5.20	8.00	5.23	7.96	5.30	7.92	5.20	7.19	5.23	7.16	5.30	7.18
5.40	8.32	5.43	8.28	5.50	8.20	5.40	7.35	5.43	7.35	5.50	7.40
6.00	8.66	6.03	8.51	6.10	8.46	6.00	7.67	6.03	7.65	6.10	7.65
6.20	8.82	6.23	8.78	6.30	8.74	6.20	.....	6.23	.....	6.30	.....
**8.20*	*10.09*	**8.27*	*10.05*	**8.35*	*10.02*	**10.16*	*9.87*	**10.23*	*9.81*	**10.28*	*9.77*

TIDE OBSERVATIONS NEAR INDIA POINT, PROVIDENCE.—*Continued.*

*Sunday, October 6, A. M.**						*Sunday, October 6, P. M.**					
Box No. 1.		Box No. 2.		Box No. 3.		Box No 1.		Box No. 2.		Box No. 3.	
TIME.	READING.	TIME.	READING.	TIME.	READ'G.	TIME.	READING.	TIME.	READING.	TIME.	READ'G.
4.40	*6.55*	*4.45*	*6.55*	*4.50*	*6.50*	*5.20*	*6.56*	*5.25*	*5.57*	*5.30*	*6.61*
11.18	*10.28*	*11.23*	*10.24*	*11.28*	*10.20*	*11.05*	*10.35*	*11.10*	*10.32*	*11.15*	*10.30*

Monday, October 7.

A. M.		A. M.		A. M.	
**5.30*	*6.56*	**5.35*	*6.58*	**5.40*	*6.60*
6.00	6.70	6.03	6.67	6.10	6.70
6.20	6.94	6.23	6.93	6.30	6.95
6.40	7.21	6.43	7.18	6.50	7.16
7 00	7.45	7.03	7.45	7.10	7.46
7.20	7.90	7.23	7.86	7.30	7.82
7.40	8.25	7.43	8.22	7.50	8.10
8.00	8.60	8.03	8.58	8.10	8.45
8.20	8.92	8.23	8.92	8.30	8.80
8.40	9.27	8.43	9.24	8.50	9.10
9.00	9.57	9.03	9.54	9.10	9.42
9.20	9.89	9.23	9.83	9.30	9.70
9.40	10.04	9.43	10.02	9.50	9.93
10.00	10.28	10.03	10.25	10.10	10.17
10.20	10.48	10.23	10.45	10.30	10.37
10.40	10.54	10.43	10.51	10.50	10.47
11.00	*10.62*	*11.03*	*10.60*	*11.10*	*10.60*
11.20	10.61	11.23	10.58	11.30	10.56
11.40	10.43	11.43	10.40	11.50	10.43

THE FOLLOWING OBSERVATIONS WERE RECORDED BY GEN. G. K. WARREN, U. S. ENGINEERS, IN HIS REPORT OF 1874.

Record of Tide-gauge kept at Hill's Wharf, Providence, by the City Water Works, from May 22 to December 28, 1873

[The observations were taken with a self-registering tide-gauge furnished by the United States Coast Survey.]

Date.	Number of high water.	Total high water.	Number of low water.	Total low water.	Notes.
May 22 to 31, 1873	17	139.51	18	57.86	
June 1 to 30, 1873	56	451.58	55	200.46	
July 1 to 31, 1873	60	486.23	60	216.95	
August 1 to 31, 1873	56	442.51	56	191.96	Two days lost.
September 1 to 30, 1873	58	467.20	58	197.97	
October 1 to 31, 1873	60	497.95	60	215.83	
November 1 to 30, 1873	58	455.23	58	192.59	
December 1 to 28, 1873	48	375.74	49	167.76	Four days lost.
	413	3,315.95	414	1,441.38	

1441.38 ÷ 414 = 3.481, mean low water.
3315.95 ÷ 413 = 8.029, mean high water.
8.029 — 3.481 = 4.548, mean rise and fall of tide.

Record of Tide-gauge kept at Bishop's Point, Pawtucket River, Rhode Island, in October and November, 1872.

Date.	High water.	Low water.	Date.	High water.	Low water.
October 13	7.6	1.1	October 28	6.8	2.0
14	7.6	1.4	29	5.8	2.0
15	6.9	1.6	30	6.8	2.2
16	7.7	1.8	31	7.7	1.9
17	7.7	1.6	November 1	7.9	2.0
18	7.7	1.5	2	7.0	1.8
19	7.0	1.6	3	7.8	1.8
20	7.0	1.6	4	7.5	1.8
21	6.5	2.0	5	7.2	1.7
22	5.9	2.1	6	7.7	1.7
23	5.6	2.2	7	7.2	2.7
24	5.6	1.6	8	6.6	1.8
25	5.7	1.9	9	6.0	1.8
26	5.8	1.7	10	6.7	2.0
27	5.9	1.6			

Whole number of days observations were made, 29. Mean high water, 6.85 on gauge; mean low water, 1.81 on gauge; mean rise and fall, 5.04 feet. Lowest tide below mean low water, 0.71 feet; highest tide above mean high water, 1.05 feet.

Record of Tide-gauge kept at Butler Hospital Wharf, Pawtucket River, Rhode Island, in April and May, 1873.

DATE.	High water.	Low water.	DATE.	High water.	Low water.
April 22	5.5	1.0	May 6	4.6	0.9
23	5.7	0.5	7	4.9	1.1
24	6.2	0.3	8	5.0	0.8
25	5.7	0.1	9	5.25	0.8
26	5.6	0.0	10	4.9	1.1
27	5.6	0.1	11	5.3	0.6
28	5.3	0.05	12	5.5	0.8
29	5.5	0.4	13	5.6	1.1
30	5.4	0.1	14	4.8	0.8
May 1	4.2	0.3	15	5.4	0.9
2	4.5	0.9	16	5.1	0.85
3	4.8	1.0	17	5.2	1.0
4	4.8	0.7	18	4.6	1.3
5	4.1	0.6	19	4.7	0.7

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State of Rhode Island and Providence Plantations.

FOURTH ANNUAL REPORT

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OF THE

Harbor Commissioners,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1880.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1880.

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The Commissioners.

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Fourth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, reappointed J. Herbert Shedd, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

OFFICE.

The office of this Board is in the building at the corner of Market Square and Canal street, in Providence, where accommodations are obtained at a rent of two hundred dollars per year.

WORK WITH U. S. GOVERNMENT APPROPRIATION.

The scheme of improvement for Providence River and Narragansett Bay, projected by the Harbor Commissioners in 1877, and toward the realization of which Congress appropriated, by act approved June 18, 1878, a sum of $50,000, was explained in detail and with the aid of plans in the last annual report of the Board. Work with this appropriation was begun October 5, 1878, under the direction of Gen. G.

K. Warren, U. S. Engineer for this district, a contract having been made by the Government with E. R. Seward, of Albany, to excavate material from the channel and deposit it in the deepest parts of Narragansett Bay, east of Conanicut Island, requiring an average towage of nineteen miles, for 11½ cents per cubic yard. The contractor abandoned his contract after removing 72,314 cubic yards of material; his contract called for the removal of about 391,000 cubic yards.

By act approved March 3, 1879, Congress appropriated an additional $60,000 toward this improvement, making a total sum thus far appropriated of $110,000, and after calling for bids for the completion of Seward's contract, and receiving only such as seemed excessive, Gen. Warren deemed it best to call for proposals in the usual manner to do work to the amount of the total appropriation remaining which it seemed proper to devote to this work,—some ninety thousand dollars. This was accordingly done. Specifications were issued "To *excavate* in Providence River, R. I., between three hundred thousand (300,000) and four hundred thousand (400,000) cubic yards in making and widening a channel twenty (20) feet deep at mean low water between Fox Point and Field's Point, where the present depth is from twelve (12) to twenty (20) feet at mean low water; and to excavate about one hundred and twenty thousand (120,000) cubic yards at Pawtuxet Shoal, in the vicinity of Riverside wharf, three and one-half (3½) miles below Fox Point, in making a channel two hundred (200) feet wide, and twenty-three (23) feet deep at mean low water, where the present depth is from seventeen (17) to twenty-three (23) feet at mean low water;" and a contract to do this was made with the Atlantic Dredging Company, of Brooklyn, N. Y., at 16 cents per cubic yard.

The bids resulting from this latter advertisement ran something like fifty per centum in advance of those made in 1877. It will be remembered that the completed improvement of Providence River and Narragansett Bay, was estimated by the Harbor Commissioners to cost $500,000, on a basis of seven yards excavation for a dollar. The accepted bid is seen to be in excess of this basis. The large price is greatly due to the excessive distance to which the dredged material must be towed before dumping—some nineteen miles—and the provision of a more convenient dumping-ground would be a very effective measure of economy.

It is a common thing, in European ports, for the local authorities to own dredging and towing apparatus, and to furnish it to those who do the work. As the towing apparatus needed for this work in Providence River is greater in proportion than is ordinarily required along our coast, the contractors are not well provided for the work, and consequently their bids are higher than they would otherwise be. A great economy would, therefore, probably be secured if the local authorities here, were to own such apparatus and furnish it at moderate rates to contractors for the work.

A serious danger to navigation, called Bulkhead Rock, lies on the easterly side of the channel, about midway between Pomham and Fuller's lights. There is now about fourteen feet depth of water at mean low tide, on the rock, but its position in the channel is such as to require twenty feet depth, by the new plan. On June 18, 1878, an appropriation of $5,000 was made by Congress, specially for its removal, but as this sum is insufficient to secure the present desired depth, operations were reserved until the required sum could be made up from the general appropriation. The work is now under contract for the removal of the rock to a depth of twenty feet at mean low water, for the sum of $7,169.00, and it is expected that this will be accomplished during the working season of 1880.

More detailed information as to the progress of the work under Gen. Warren, will be found in his communication to this Board, and in his report to the Chief of United States Engineers, of which he has kindly sent us advance sheets. These will be found printed in the appendix to this report. It is a source of gratification to the Board, that on the first of December, 1879, the Atlantic Dredging Company, by the removal of material from that part of Providence River above Sassafras Point had secured a depth of 20 feet at mean low water, across the bar which has been such an obstacle to the free use of Providence Harbor by sea-going vessels of deep draught. The dredging is still going on for the purpose of widening this channel, with the result that to-day sea-going vessels of twenty feet draught may come from the ocean to our upper harbor at nearly all stages of the tide, and vessels of twenty-three feet draught may come in at certain stages of the tide.

DUMPING-GROUND.

The dumping-ground described in the specifications for Government work was: the deepest parts of Narragansett Bay, lying between Half-way Rock, Gould Island, Rhode Island and Conanicut Island. Besides this the Harbor Commissioners authorized a temporary dumping-ground for private parties dredging in Pawtucket River, on the west side thereof below Tide Water street, and within three hundred feet of high water mark, provided no objection is made by riparian owners.

HARBOR LINES.

In the third annual report of the Board, a plan for a new harbor line on the east side of Providence River from Crawford street bridge to Fox Point, is mentioned as before the General Assembly for action. This harbor line was established by chapter 758, of the Public Laws, passed April 10, 1879.

A plan of harbor lines on both sides of Seekonk River, near India Point, and on the east side of the harbor from Bold Point to Kettle Point, is also mentioned in the third annual report, as before the General Assembly for action. These lines were established by chapter 759, of the Public Laws, passed April 10, 1879.

It is also mentioned in the above named report that the Board had under consideration the establishment of a harbor line, from a point some 1,900 feet north of Sassafras Point to Field's Point, cutting off at the latter place, the long, low sand spit, therein described. Such a line has been designed, and will be presented to the General Assembly for action.

Riparian owners on Barrington River having petitioned the Board to mark harbor lines on both sides of said river from the railroad bridge, southerly to its junction with the Warren River, and having guaranteed the cost of surveying and plans, such lines have been designed and will be presented to the Governor and Senate for approval.

The petition for the harbor line in Barrington River was prompted by a controversy, which occurred between the above-mentioned riparian owners and John Bowden. Bowden, after having driven piles in ground lying under the waters of Barrington River, leased to him by the Commissioners of Shell Fisheries for the purpose of planting oysters, applied to this Board for license to erect a building on them. The riparian owners formally protested. Several hearings were held; but, pending any official utterance or action on the part of the Board, Bowden began building. At length, having obtained the opinion of the Attorney-General as to the authority of the Board, notice was served on Bowden by the sheriff, directing him to desist in his work, and to pull up the piles. As Bowden still proceeded to build, the Board wrote to the Attorney-General, asking prosecution as a public nuisance, but before the Attorney-General's reply was received, or any action taken, by the State, Bowden's structure was demolished without authority of the Board.

BROOK STREET DISTRICT IMPROVEMENT.

Nothing has been done by the city of Providence to change the condition of the work between Bower street and Front street on the Seekonk River, except to fill a thousand yards, more or less, of earth into the depression back of the embankment. The embankment seems to be not yet stable but has settled something more than a foot in the year ending November 7, 1879, and the rolling motion still continues, in a slight degree. As we said in our last report, "the filling back of the embankment, as proposed, will add a new load, and the dredging away of the earth at the foot of the embankment will remove a present support," and the indications are that when either of these things is done, the rapid outward motion of the filling, into the channel, will continue. We have called the attention of the City authorities to the need for dredging at this place and have been assured that the work will go on as soon as the weather is suitable in the Spring.

BRIDGES IN SEEKONK RIVER.

In their last annual report, the Harbor Commissioners gave a detailed account of the condition of the Seekonk River tides, showing that they had lost some sixteen per centum of their original scouring effect by reason of the bridges and their foundations. Their discussion exhibited the foundations of the bridges as practical dams, and showed how the effect of an error of judgment in the last century, had in the course of time, and by the lack of skillful management, grown to such serious proportions as to cause the United States Engineer to say that it seemed to him out of place, while the present condition of things existed, to regard the Pawtucket River,—a stream with a town of 30,000 inhabitants at its head, naturally navigable, and whose conservancy is of very high importance to the State,—as longer "a navigable water of the United States." "Three separate influences," they said in conclusion, "urge a radical change in regard to the bridges which span the Pawtucket navigation at the mouth of the river. First, the injurious effect of the present structures, considered as obstructions, on the tidal flow, and the resulting evils, which we have endeavored to make manifest in our discussion of the tides. Second, the highly objectionable location of the draws; and Third, the fact that in event of no change in the matter, the river is likely to be dropped from the consideration of the General Government."

The condition of the Seekonk River seems to the Board to call imperatively for action. There are involved in its improvement several questions, which require careful consideration. The bridging of a navigation in the best possible way requires at all times exceedingly good judgment, and the peculiar formation of the Seekonk River, makes it, perhaps, more than usually necessary. What may arise from lack of proper appreciation of the matter in all its bearings is sufficiently exhibited by the present condition of the river itself. The idea of the original constructors seems to have been but little more comprehensive than to get from the hither shore to the farther bank, dry-shod. This is, indeed, the grand idea of all bridge construction;

but by the time the fallen tree of the savage has given place to truss and abutment, there have arisen, it is hardly necessary to say, several important collateral considerations.

To ensure, as far as possible, properly conducted improvement seems to the Board to require that the case should be put in the hands of a specially appointed commission, with instructions to study thoroughly the whole subject of obstructions to tidal flow and navigation in the Seekonk River, and to report its conclusions for action by the State government. The Board very earnestly urges the appointment of such a commission.

FOULING OF SEEKONK RIVER.

On several occasions during the month of September, the water of the Seekonk River was observed to be seriously fouled and burdened by great quantities of comminuted matter held in suspension. This matter gave the water a dark, mahogany color, affecting it from surface to bottom, and its quantity may be estimated, perhaps, in thousands of yards. Its appearance suggested that it might be the detritus of deposits made for considerable periods during the past, below print works and tanneries, although the commissioners have been unsuccessful in definitely tracing it to its source. The eventual deposit of so large a quantity of matter on the bed of the river, and the consequent shoaling, make the case worthy of serious notice, and the Board is yet in doubt whether similar occurrences, even if foreseen, can be prevented in the future, without further special legislation.

A large amount of deposit is brought into tide-water by the Woonasquatucket and the Moshassuck rivers, and extensive shoaling is constantly going on. The whole question is worthy of consideration, and may require such enactments on the part of the legislature as will prevent injury to navigation by the discharge of refuse into the rivers of the State.

LICENSES, &C.

The following licenses have been issued:

1. April 22, to Dewing & Monsell to extend their wharf, lying to the south of Doubloon street on the east side of Providence River, to the harbor line, by the construction of some 450 running feet of pile and plank work.

2. July 2, to Henry G. Russell to repair wharf occupied by Winsor Line, opposite India street in Providence, by the construction of some 218 running feet of pile and plank work.

3. December 31, to New York, Providence and Boston Railroad Company to construct 80 x 600 feet pile pier, connected with the shore by 400 feet of double track, and 500 feet of single track bridge; also 600 running feet of rubble-stone retaining wall; all on property in the vicinity of Sassafras Point, Providence.

January 23, 1879, assent was given to closing the Old Colony Railroad drawbridge at Tiverton, by the railroad company, from January 26 to February 2, inclusive, for the purpose of putting up a new draw.

January 28, assent to extension of time to February 9, inclusive.

October 29, assent was given to construction of a pile and plank bulkhead at Sabin's Point, by Smith & Wright, extending 100 feet sea-ward from existing bulkhead, and being 140 feet along the front. As there is no harbor line opposite this construction, a formal license was not issued, but the action of the Board was based upon an opinion obtained from the Attorney-General as to powers and duties of the Board, where no harbor lines exist.

WORK OF THE UNITED STATES ENGINEER.

By the courtesy of Gen. G. K. Warren, the Board has received advance sheets of his report upon the government works under his charge in Rhode Island, for the year ending June 30, 1879, and a communication, describing the progress of the Providence River improvement to December 1, 1879. The following is a brief summary from these. The report of Gen. Warren, and his communication, will be found in full in the appendix.

Pawtucket, or Seekonk River, Rhode Island.

Nothing was done beyond making a few tidal observations and levellings. It is proposed to continue these in the ensuing year, and to sound over some of the shoals, that are said to have formed since the dredging operations of 1875.

Providence River and Narragansett Bay, Rhode Island.

The project for this improvement consists in making a wide channel with a central depth of 23 feet at mean low water, from Providence to the sea, at an estimated cost of about $500,000.

Under contract made, with the appropriation of June 18, 1878—$50,000—72,134 cubic yards of material were removed. The contract was then abandoned. With what remained of this appropriation, and such portion of the appropriation of March 3, 1879—$60,000—as it was thought best to employ, a new contract for dredging has been made. Up to December 1, 1879, 85,271 cubic yards of material had been removed under it.

With the $5,000 specially appropriated for the removal of Bulkhead Rock, supplemented by a portion of the general appropriation, a contract has been made to remove the rock to a depth of 20 feet at mean low water. This work will be begun in the early spring of 1880.

The amount estimated necessary to complete this improvement is $390,000, of which $100,000 could be judiciously expended during the next fiscal year.

Block Island Harbor, Rhode Island.

During the last year 2,927 tons of rip-rap stone have been deposited on the breakwater, and the harbor for local purposes completed. No other work is anticipated, and no further appropriation recommended.

Little Narragansett Bay, Rhode Island and Connecticut.

This improvement is designed to make a safe channel through the shoals, where the ruling depth is now 4½ feet at mean low water, of not less than 7½ feet at mean low water, and 200 feet width. The mean range of the tide is about 2½ feet.

The contract made in 1878 was completed June 30, 1879. Under it 19,776.85 cubic yards of material, including bowlders of 1 cubic yard, and 348.60 cubic yards of bowlders of larger size were removed. The channel completed around Pawtucket Point is 7½ feet deep at mean low water, about 900 feet long, and 185 feet wide.

Act of Congress approved March 3, 1879, appropriated $5,000 for the continuation of this improvement, but it is not yet available.

The amount necessary to complete the projected improvement is $31,000. It is desirable that $20,000 should be appropriated for the fiscal year ending June 30, 1881.

The United States Advisory Council is still composed of Rear Admiral Daniel Ammen, U. S. N., Brevet Major-General G. K. Warren, U. S. A., and Prof. Henry Mitchell, U. S. C. and G. S.

Respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

APPENDIX.

A.

ABSTRACT OF REPORT OF GEN. G. K. WARREN TO CHIEF OF UNITED STATES ENGINEERS, FOR 1879; AND COMMUNICATION RELATIVE TO PROGRESS OF WORK IN PROVIDENCE HARBOR.

Improvement of Pawtucket (Seekonk) River, Rhode Island.

DESCRIPTION OF LOCALITY.

This is an estuary forming the continuation of Providence River from Providence to Pawtucket, a distance of 5 miles, and forms a shoal tidal basin of about 1¼ square miles. The navigation is seriously obstructed by a badly arranged draw-bridge near its lower end, at East Providence. The ruling low-water channel depth before it was improved was 5 feet. The mean rise of the tide is about 5 feet at Pawtucket. It was dredged till the ruling depth at mean low-water was 7 feet, and least channel width of 75 feet.

HISTORY.

Dredging was begun (by an appropriation from the general government) in 1868, $17,000 being allotted; in 1870, $8,000 was appropriated; in 1871, $7,000; in 1872, $10,000; in 1873, $10,000; in all $52,000. For details see Annual Report 1874, pp. 227 to 237, Part II.

WORK DURING LAST FISCAL YEAR.

Nothing was done beyond making a few tidal observations and levelings to test the high and low water determinations and bench-marks made in the survey of 1873. These were verified as closely as the engineering operations had rendered necessary. Since then the city of Providence has been extending streets into the tidal basin, and there has been talk of rebuilding the bad draw-bridge.

Questions about the tides have arisen in the discussion of questions relating to these matters, which, whether practical or not, require somewhat nearer determinations than those heretofore made.

WORK DURING THE ENSUING FISCAL YEAR.

It is proposed to make some repeated levelings and tidal observations, and to sound over some of the shoals that are said to have formed since the dredging operations in 1875. No appropriation is asked for.

IMPORTANCE OF THE IMPROVEMENT.

Pawtucket is a town of about 30,000 inhabitants, largely engaged in manufactures. In 1878 there were 350 schooners and 14 barges towed up the improved channel, having a freight of about 100,000 tons.

It is in the Providence collection-district, that place being the nearest port of entry. The revenue collected there in the past fiscal year is $145,187 79.

MONEY STATEMENT.

July 1, 1878, amount available	$1,383 53
July 1, 1879, amount expended during fiscal year	281 73
July 1, 1879, amount available	$1,101 80

Improvement of Providence River and Narragansett Bay, Rhode Island.

LOCALITY OF IMPROVEMENT.

Providence River is an estuary of Narragansett Bay, extending from Nayat Point to the city of Providence. Its length is about 7 miles, with a width varying from 1,000 feet to 2 miles, and a depth in the channel varying from 12 feet to 50 feet at mean low-water, with a mean rise of tide of 4.7 feet. Near its head this estuary is joined by another, called the Seekonk or Pawtucket River, extending 5 miles further, to the town of Pawtucket. The Providence River also contains Bulkhead Rock, for whose partial removal there is an unexpended special appropriation of $5,000. All the improvement thus far included under the title of this work is situated in the limits of Providence River, except a possible deepening upon a shoal below Nayat Point and above Rocky Point, to facilitate the navigation by means of the west entrance to the bay; it is not in the way, using the middle entrance to the bay.

HISTORY OF PREVIOUS IMPROVEMENT.

According to the records we have, a survey was made of Providence Harbor by Lieut. Wm. S. Rosecrans, United States Engineers, under an appropriation made by the city, which was completed in March, 1853. In 1852, an appropriation of $5,000 was made, and this was expended by Capt George Dutton, United States Engineers, in dredging, in 1853, at the "Crook"—a bad shoal then existing just below Fox Point, and having a depth of only "4.8 feet at low tide." The dredging was carried to 9 feet depth at low-water, over an area of 50 yards by 280 yards.

The next appropriation was $25,000, made in 1867, based on an estimate made by an assistant of the United States Coast Survey, (Mr. F. P. Webber). This was expended in 1867, by Colonel D. C. Houston, United States Engineers, in dredging at the locality of the "Crook," with the exception of $2,000 employed to remove a wreck opposite Sabin's Point. With this dredging a depth of 12 feet at low-water was secured up to Fox Point.

In 1870, another appropriation of $5,000 was made by Congress which was expended under my direction at the locality of the "Crook" (which itself may be said to have been removed), and a depth of 14 feet at mean low-water secured up to the wharves at Fox Point. (For details of foregoing, see Annual Report, 1871, pp. 727-730).

On June 10, 1872, another appropriation was made. It was $10,000, and was all expended under my direction in widening the channel just below Fox Point. A survey was made this year, as authorized by Congress, with a view to cutting off the "point of long bed," on the east side of the channel, opposite Sassafras Point. (See Annual Report for 1872, p. 820; and for 1873, pp. 968-970).

On March 3, 1873, an appropriation of $10,000 was made, which was all expended in removing the point of long bed. (See Annual Report for 1874, pp. 237-239). This practically completed the improvement by dredging as far as it was needed for the use of coasting-vessels. The city had also expended largely in deepening about the wharves.

HISTORY OF REMOVAL OF BULKHEAD ROCK.

An estimate for removing this so as to give a depth of 14 feet at mean low-water was made by Capt. A. H. Holgate, United States Engineers, in June, 1870, at a cost of $2,500. Its least depth then was 8 feet at mean low-water. A depth about that sought was secured that year by large blasts of gun-powder placed upon the rock.

In the Annual Report for 1875, p. 291, an estimate was submitted to increase the depth to 18 feet at mean low-water, requiring an appropriation of $5,000. This was renewed in the Annual Report for 1876, part I, pp. 207-208; and again in the Annual Report for 1877, part I, p. 199.

On June 18, 1878, an appropriation of $5,000 was made for removing this rock, but operations upon it were reserved, for the reason that the new plan requires greater depth. (Annual Report for 1878, part I, p. 232, par. 3.)

HISTORY OF THE IMPROVEMENT FOR LARGE SEA-GOING VESSELS.

This is given in detail in the last Annual Report (part I, pp. 231-241) up to the beginning of the present fiscal year. In brief, this improvement was designed at first by the Board of Harbor Commissioners of Rhode Island, with a view to obtaining a free channel-way from Providence to the Ocean, having a depth of 23 feet at mean low-water and least width of 400 feet, besides an enlarged basin for anchorage of a somewhat less depth shoaling up to 10 feet at an extreme width of 800 feet. This was to cost, in round numbers, $500,000. The plan was submitted to an advisory council, appointed by request, by the President of the United States, of which Rear-Admiral Daniel Ammen was chairman. This council changed the plan somewhat, so as to make the 23 feet mean low-water channel only 150 feet wide, gradually shoaling to 12 feet on an extreme width of 940 feet, and to 6 feet at an extreme width of 1,060 feet; the channel-way to be symmetrical in cross-section with the greatest depth in the middle. This was also estimated to cost about $500,000. After being memorialized, Congress referred the matter to the War Department for a report, which was made by myself. I submitted an estimate for work during the next fiscal year (the one just closed) of $100,000, to make a channel 23 feet deep at mean low-water 200 feet wide, to at once open the harbor to ocean steamers to the greatest depth proposed, leaving the widening to be a subsequent matter. Congress, however, appropriated only $50,000 for this purpose. The interests of Providence, as represented by some of its most prominent public and business men, it was thought, in view of the amount appropriated, would be best served by commencing the center line of the new channel at a depth of 20 feet at mean low-water, and carrying it through between Fox Point and Field's Point to a width as great as the money would allow. This latter course was adopted by the Engineer Department.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1879.

Advertisements for proposals for dredging were issued August 5, and the following proposals received :—

Abstract of proposals received at the Engineer Office, U. S. A., Newport, R. I., August 20, 1878, for excavation in Providence River, R. I.

Name and address of bidder.	Price per cubic yd.	Commence.	Complete.	$45,000 will pay for—
		1878.	1879.	Yards.
E. R. Seward, Albany, N. Y	$0 11½	Sept. 10.	June 30.	391,304.
George C. Fobes & Co., Baltimore, Md	13¾	....	June 30.	327,272.
S. A. Hammond, Bridgeport, Conn	13⅞	Sept. 2.	June 30.	324,324.
Atlantic Dredging Co., Brooklyn, N. Y.	14½	Oct. 1.	July 1.	310,344.
M. F. Brainard, Albany, N. Y	14½	Oct. 1.	June 30.	310,344.
Morris & Cumings Dredging Co., New York	16	Sept. 10.	Aug. 1.	281,250,
John A. Bouker, New York	18	Oct. 1.	July 1.	250,000.
H. N. & A. J. Beardsley, Bridgeport, Conn	20	Oct. 1.	June 30.	225,000.
Jesse & Lyman Boynton, Boston, Mass., and Providence, R. I	25	Sept. 15.	Jan. 1.	180,000.

Abstract of contract for excavation in Providence River, R. I.

Name and address of contractor.	Date of contract.	Commence.	Complete.
E. R. Seward, Albany, N. Y.	Aug. 22, 1878.	Sept. 10, 1878.	June 30, 1879.

The contractor did not commence work until October 5, 1878. He had a large dredge of the clam-shell pattern, capable of dredging probably from 2,000 to 3,000 cubic yards per day, six scows of 200 yards capacity each, and a steam-tug. The power of the tug and capacity of the scows, owing to the distance to the dumping ground, were insufficient to keep the dredge employed continuously. The work was prosecuted up to December, 25, 1878. The weather then became too cold to successfully carry it on. The contractor sent his dredge to New York, ostensibly for the purpose of repairing, or completing the necessary repairs. Work was to have been renewed, weather permitting.

During the time the work of dredging was in progress there was removed from the channel 72,314 cubic yards of mud. This excavation made a cut 3,100 feet long, 70 feet wide, and 20 feet deep at mean low water. The material was nearly all deposited in the deep water of Narragansett Bay, between Half-way Rock and Gould Island, and Conanicut Island and Rhode Island.

The amount of work accomplished was not satisfactory. The contractor was duly notified that his rate of progress was too slow. On his assurance of putting on additional machinery and prosecuting the work in the spring with vigor he was allowed to continue with what facilities he had. It was then too late in the fall to make arrangements to put other parties on the work that season, and it was not deemed advisable to make new arrangements for the spring work, as the contractor was confident of his ability to then make the desired rate of progress. The winter was unusually long and severe, and it was not until April that the weather was suitable for the resumption of work. The contractor was urged to begin as soon as possible. He promised to have two dredges on the work by April 1. Under date of March 19, 1878, he wrote that he was unable to procure suitable dump scows; after this no word was received from him, and communications sent to him were unnoticed, although I had evidence of their being received. He and his bondsmen were then notified that the terms of the contract had not been complied with, and that other parties would be invited to bid for the completion of the work, and that the said bondsmen would be held responsible for any increased cost.

The following offers were received in answer to letters addressed, asking for prices for doing the whole or part of the work:

H. N. & A. J. Beardsley, Bridgeport, Conn.	19¼ cents per yard.
Atlantic Dredging Company, Brooklyn, N. Y.	19½ cents per yard.
Morris & Cuming's Dredging Company, New York City.	20 cents per yard.
George C. Fobes & Co., Baltimore, Md.	21⅝ cents per yard.

The lowest bid received was 19½ cents per cubic yard, which is 8 cents per yard in excess of the contract price. The prices given were considered excessive, and for this reason, and because the contractors' bonds were not large enough to cover the difference, the offers were rejected. Mr. Seward's contract called for the removal of about 391,000 cubic yards; deducting 72,314 cubic yards removed, leaves 318,686 cubic yards to be dredged to complete the contract; this latter number of yards, at 8 cents per cubic yard (the difference between the contract price, 11¼ cents, and the lowest offer received, 19¼ cents), amounts to $25,494.88. The reserve held on work done (10 per cent.) is $831.62. The amount of bond given for faithful performance of contract was $5000, which amount, if added to the reserve and subtracted from $25,494.88 (the amount necessary to complete the contract at the increased price), would leave a deficit of $19,663.26.

The dumping ground for this work is 19 miles from Providence and it is because of this great distance that all excavated material must be towed, that the prices asked were so high. The ground was selected as the nearest place known to me, where objections could not be raised to the dumping. In the work in Providence River under my direction in previous years, many complaints were made of dumping done to the injury of property on the adjoining shores. A law of the State of Rhode Island prohibits dumping on the east side of Providence River below Devil's Hand Rock. The State Board of Harbor Commissioners are unwilling to have any material dumped except at or in the vicinity of the dumping-ground selected or on the flats in Providence Harbor above Sassafras Point. The water at the latter place is too shoal to permit dumping except at high-water.

It is proposed to withhold the remainder of the appropriation of $50,000 made by act approved June 18, 1878, until the appropriation of $60,000 by act approved March 3, 1879, is made available, and then to invite proposals in the usual manner for the whole amount. It is thought that the interests of the government will be best served by so doing, as it will offer greater inducements to procure suitable means to perform the work.

This work has been under the superintendence of Mr. H. A. Bentley, assistant engineer.

BULKHEAD ROCK.

This rock, as before stated, was removed to about 14 feet depth, under an appropriation of $2,500 made in 1870. The line of the east side of the proposed channel, by the new plan of improvement, extends east of the rock, and to make the required width and depth at this point requires a depth of 20 feet at mean low-water on Bulkhead Rock. Advertisements were issued for doing this under date of May 30, 1879, and the following bids were received:

Abstract of proposals received at the Engineer Office, U. S. A., June 26, 1879, at 12 m., for the removal of Bulkhead Rock, Providence River, R. I., to a depth of 20 feet at mean low-water.

Name and address of bidder.	Price.	Commence	Complete.	Remarks.
David V. Howell, Savannah, Ga.	$3,922 00	Sept. 1, 1879	June 30, 1880	Bid Informal.
Isaac A. Sylvester, Newton, Mass.	7,169 00	....	June 30, 1880	
Geo. W. Townsend, 214 Atlantic ave., Boston, Mass	7,860 00	....	June 30, 1880	

The contract will be awarded to the lowest bidder, Mr. D. V. Howell, on his furnishing evidence of his ability to perform the work, and satisfactory bonds.

THE PROBABLE OPERATIONS DURING NEXT FISCAL YEAR.

Will be the continuation of the dredging above Field's Point to make a depth of 20 feet at mean low-water and a channel of 23 feet depth and 200 feet width through Pawtuxet shoal and the removal of Bulkhead Rock to a depth of 20 feet at mean low-water.

The amount of money estimated necessary to complete this improvement is $390,000, of which $100,000 could be expended judiciously during the next fiscal year.

IMPORTANCE OF THE IMPROVEMENT.

Providence is a city of about 100,000 inhabitants and is the second city in size and importance in New England. It is a manufacturing city of importance. Large quantities of arms of war are made here. It is a very convenient distributing point, and its fine approaches from the ocean will give it a large opportunity for foreign trade as soon as the contemplated deep channel is secured.

The total number of vessels that arrived at the port of Providence during the year 1878 was 5,580, of which 1,975 were steamers from Baltimore, Philadelphia, New York, Fall River, and Newport; 3,440 were barks, brigs, schooners, sloops, and barges from various American ports, and 112 foreign barks, brigs, and schooners. Providence is in the Providence collection district, and that place is a port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1879, was $145,187.79.

MONEY STATEMENT.

Improvement of Providence River and Narragansett Bay.

July 1, 1878, amount available	$50,000 00	
Amount appropriated by act approved March 3, 1879	60,000 00	$110,000 00
July 1, 1879, amount expended during fiscal year	10,532 69	
July 1, 1879, outstanding liabilities	831 62	11,364 31
July 1, 1879, amount available		98.635 69
Amount (estimated) required for completion of existing project		390,000 00
Amount that can be profitably expended in fiscal year ending June 30th, 1881		100,000 00

Improvement of Providence River—Removal of Bulkhead Rock.

July 1, 1878, amount available	$5,000 00
July 1, 1879, amount expended during fiscal year	5 20
July 1, 1879, amount available	4,994 80

Improvement of Block Island Harbor, Rhode Island.

ITS LOCATION AND SIZE.

It is placed on the east side of the island toward its south end. It consists of an inner harbor of about 1¼ acres having a mean low-water depth of 7 feet. This little harbor is composed of stone up to the level of low-water, and then of a timber crib filled with stone, the inner side being lined with piling to protect the vessels. It is entered by an opening 60 feet wide. Outside of this is a larger sheltered place secured from gales except in the northeast quarter, (which are not serious,) and from which a partial shelter suffices. This outer harbor is formed by a breakwater of rip-rap granite, extending out about 1,100 feet beyond the inner harbor; then there is an opening of 200 feet with a depth of 18 feet at mean low-water; then a detached piece curving to the westward which is 300 feet long terminating in about 24 feet depth at mean low-water. Another piece detached again can at some future time be added extending towards the shore so as to greatly increase the completely sheltered area, and by dredging the depth can be made 24 feet at mean low-water. The mean rise of the tide is about 3 feet. A steamboat wharf has been built just outside the inner harbor, and all the facilities necessary to the local wants of the island, and its use as a summer resort, are provided. The lighting of its approaches is now in charge of the Light-House Department.

This harbor is an enlarged modification of the original design of a harbor for local purposes. The first plan was to build it of riprap up to low-water and surmount this with a cut-stone parapet. The change permitted the enlargement of the area and a reduction of the cost.

IMPORTANCE OF THE WORK.

Block Island is about 9 miles long and 4 miles broad with a permanent population of about 1,400 souls. Heretofore their means of living was by fishing and farming, and their want of harbors made them very isolated. There are no rocks *in situ* to form long projecting headlands and sheltered areas, the formation being of sand, clay, gravel, and ancient glacial deposits, gradually undermined by the waves and leaving a dangerous surf-beaten shore. The island is about 10 miles from the mainland at Point Judith, about 13 miles from Montauk Point on the west, and about 39 miles from No Man's Land and Martha's Vineyard on the east. A depth of water for the largest ships exists all around it. Since the harbor was begun a first-class light-house and fog-signaling apparatus has been erected on the southeast part of the island, making it a most desirable point to correct the ship's reckoning on approaching the shore, since a safe lee can be made on one side or the other of the island, and pilots found ready to conduct them to port. Here the government has also provided a life-saving station in the shelter of the breakwater. A light-house has for a long time existed on the north end of the island, and there only appears to be wanting now a good fog-signal on the southwest end of the island, to guide vessels coming out of the Long Island Sound and going to sea between the island and Montauk light, and also the coasters going eastward outside of Long Island, on their way to Vineyard Sound and Buzzard's Bay. More wrecks are made on this southwest shore than on any other part of the island.

The completion of the inner harbor led to the acquirement by the islanders of several decked schooners, which they could not have before, no craft being admissible that could not be hauled on the shore in storms beyond the reach of the waves. Fishing-smacks from great distances also seek shelter here, and thus the capacity of the harbor is fully tried at times. Were a larger harbor constructed it would often be filled with coasters, to which it would furnish a much needed shelter between Long Island and Vineyard Sounds.

The deep water all around the island always makes it possible for vessels to find shelter behind it from any winds; but the sudden changes which generally occur from heavy southeast gales to equally strong ones from the northwest, prevent any ordinary coasting-vessels seeking the northwest side to escape the southeasters (which are the most destructive on account of high-tides and waves), for unless manned by large crews, as the mackerel men only are, the sudden changes would catch them before they could escape from the lee shore.

The island, however, would readily furnish this shelter to a fleet of war steamers ready to move with a change of the wind, so that the objection sometimes made to constructing a large harbor here because it might be of advantage to an enemy in war has but little weight. The immediate effect of the new harbor has been to much increase the fishing facilities and wealth of the island, and to furnish a means of convenient landing for an ocean summer resort that is increasing in importance at a very rapid rate. It has led to increased facilities for ocean navigation, and when connected with the main land by telegraph, as it probably soon will, will be the advanced post to signal the approach of European vessels to our shores. It is probably but the beginning of a greater harbor of more general value to the coasting navigation.

WORK DURING THE PAST FISCAL YEAR.

Under a contract before made, some riprap stone was being deposited to fill up places that had settled during the storms of the previous winter. This was completed during the last season, 2,927 tons having been deposited. This completed the harbor as constructed for local purposes. In the beginning of 1879 the Light-House Department assumed charge of lighting the entrance; our superintendence over the structure ceased, and the public property employed on the work was transferred elsewhere or disposed of by public sale. A small remainder of the appropriation will be used in preparing a detailed account and drawings illustrative of the work when the present season's work elsewhere closes. No other work is now anticipated, and no further appropriation is recommended.

BRIEF HISTORY OF THE IMPROVEMENT.

The breakwater was commenced in October, 1870, and completed in November, 1878. The amount of stone used in its construction was about 95,000 tons. The inner harbor was built in 1871 and 1872. The crib-work contains about 320,000 feet (board measure) of timber and 6,000 tons of stone. This inner harbor was dredged to 7 feet depth at mean low-water in 1872 and 1873. The depth before dredging was from 0 to 4½ feet. There has been removed from the sheltered anchorage about 3,000 tons of bowlders.

Block Island is in the Newport collection-district, and Newport is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1879, was $1,811.01.

MONEY STATEMENT.

July 1, 1878, amount available	$5,554 72
July 1, 1879, amount expended during the fiscal year	5,209 19
July 1, 1879, amount available	345 53

Improvement of Little Narragansett Bay, Rhode Island and Connecticut.

LOCALITY OF IMPROVEMENT.

Little Narragansett Bay is at the mouth of Pawcatuck River and is between Stonington and Watch Hill. It is separated from the ocean by a narrow sand beach extending from Watch Hill toward Stonington, a distance of about 3 miles, leaving an opening between its end and Stonington of about 1 mile. The water in this bay is shoal; 4½ feet at mean low-water is the greatest depth that can be carried across it. The Pawcatuck River, navigable to Westerly, a distance about 5 miles from its mouth, can only be approached through this bay; this river has been improved by the general government under my direction so that there is now a channel 75 feet wide and 5½ feet deep at mean low-water up to Westerly. The mean rise of the tide is about 2 6-10 feet.

HISTORY OF PREVIOUS IMPROVEMENT.

The river and harbor act of March 3, 1875, directed a survey of this bay, which was made during the summer of 1875, and reported on November 30, 1875. (See Annual Report for 1876, Part I, pp. 217 *et seq.*) The improvement recommended in this report was for a channel 200 feet wide and 7½ feet deep at mean low-water, extending across the north shore of the bay from Pawcatuck Point to the deep water near the mouth of the bay opposite Sandy Point, and the removal of dangerous rocks in the channel near Rhodes' Folly and Watch Hill The estimated cost of this improvement was $51,000.

Congress by act of August 14, 1876, appropriated $5,000 for the work. This money was expended in removing the rocks near Rhodes' Folly and in dredging and removing rocks from the east end of the proposed channel at Pawcatuck Point.

WORK EXECUTED DURING FISCAL YEAR ENDING JUNE 30, 1879.

By act of Congress approved June 18, 1878, an appropriation of $10,000 was made for the continuation of the improvement. Advertisements for proposals for excavation were issued August 5, 1878. The following tenders were received in answer to the advertisement:

Abstract of proposals received at the Engineers Office, U. S. A., Newport, R. I., on Tuesday, August 20, 1878, for excavation in Little Narragansett Bay, Rhode Island and Connecticut.

Name and address.	Price for material including bowlders of one cubic yard.	Price for bowlders over one cubic yard.	Commence.	Complete.	Quantities called for will cost—
			1878.	1879.	
E. R. Seward, Albany, N. Y	$0 30	$6 75	Sept. 2	June 30	$8,422 50
Morris & Cumming's Dredging Co., N. Y. City	40	6 00	....	June 30	9,880 00
S. A Hammond, Bridgeport, Conn	35	9 00	Sept. 2	June 30	10.332 50
James Caler, Stamford, Conn	35	9 00	Nov. 1	June 30	10,332 50
George C. Fobes & Co., Baltimore, Md	58	2 80	....	June 30	11,671 00
Morris F. Brainard, Albany, N. Y	1 25	For all.	Sept. 10	June 30	23,000 00

Abstract of contract for excavation in Little Narragansett Bay, Rhode Island and Connecticut.

Name and address of contractor.	Date of contract.	Commence.	Complete.
E. R. Seward, Albany, N. Y	Aug. 22, 1878	Sept. 2, 1878	June 30, 1879

Mr. Seward arranged with Mr. S. A. Hammond, of Bridgeport, to do this work for him. Operations were begun August 30, with a dredge and dump-scows, a tug, and a stone-scow with steam hoisting apparatus. The work was continued until December 23, when it had to be suspended because of the cold weather. It was resumed again April 3, 1879, and continued until June 30, when the contract was completed.

There were removed under this contract 19,776.85 cubic yards of material, including bowlders of 1 cubic yard, and 348.60 cubic yards of bowlders of a larger size than one cubic yard. The channel completed around Pawcatuck Point is 7½ feet deep at mean low-water, about 900 feet long, and 185 feet wide. It is thought that the work done embraces all the difficult excavation that will be encountered, with the exception of 15 feet additional width necessary to make the required width of channel of 200 feet. This work has been under the superintendence of Mr. H. A. Bentley, assistant engineer.

PROBABLE OPERATIONS DURING THE NEXT FISCAL YEAR.

The act of Congress approved March 3, 1879, appropriated $5,000 for the continuation of this improvement, but the money has not yet been made available. It is proposed with this money to excavate a channel of a depth of 7¼ feet at mean low-water, and of as great a width as the money will pay for, from the channel already made at Pawcatuck Point to the deep water opposite Sandy Point. This will be done during the year if the money is made available in time. Mr. Hammond will also be employed for a short time in cleaning up the cuts already made.

The amount of money necessary to complete the projected improvement is $31,000. It is desirable that $20,000 should be appropriated for the fiscal year ending June 30, 1881, as this amount would probably secure a channel that could be navigated, although not of the required width.

IMPORTANCE OF THE IMPROVEMENT.

The places that will be benefited by this improvement are Westerly and Watch Hill. Westerly is a manufacturing village on the Pawcatuck River. It has fine stone-quarries, and is generally a thriving town. The full value of the improvement of the Pawcatuck River made by the general government cannot be realized until the projected improvement in the bay is completed. This improvement will also be of the greatest value to Watch Hill, which has its only landing in the bay. Watch Hill is a popular summer resort where 45,000 passengers were landed from the steamboats during the past year.

The number of vessels taken through Little Narragansett Bay during the year 1878 was 205 There were 31 vessels drawing too much water to cross the bay that were lightered at Stonington and their cargoes taken to Westerly.

The accompanying map, in 3 sheets, of Pawcatuck River and Little Narragansett Bay shows the present condition of the water communication between Westerly and Watch Hill with the sound, and the proposed improvement.

Little Narragansett Bay is in the collection-districts of Providence and Stonington; the latter is the nearest port of entry. The revenue collected during the fiscal year ending June 30, 1879, was: Providence, $145,187.79; Stonington, $1,811.49.

MONEY STATEMENT.

July 1, 1878, amount available	$10,679 38	
Amount appropriated by act approved March 3, 1879	5,000 00	$15,679 38
July 1, 1879, amount expended during fiscal year	8,156 81	
July 1, 1879, outstanding liabilities	828 60	8,985 41
July 1, 1879, amount available		6,693 97
Amount (estimated) required for completion of existing project		31,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881		20,000 00

COMMUNICATION FROM GEN. G. K. WARREN.

ENGINEER OFFICE U. S. ARMY,
NEWPORT, R. I., January 8, 1880.

To the Chairman, Harbor Commissioners State of Rhode Island:

SIR: The following is a résumé of operations for the improvement of Providence River from June 30. the date of my annual report to the Chief of Engineers, to Dec. 1st, 1879. The appropriation of $60,000 for this improvement, by act of Congress approved March 3, 1879, was made available July 30, 1879.

Advertisements for dredging under this appropriation, and the remainder of the appropriation of $50,000 by act approved June 18, 1878; were issued August 6, 1879, and on the 26th the following bids were received.

Atlantic Dredging Co., Brooklyn, N. Y.	16	cents	per	cubic yard.
H. N. & A. J. Beardsley, Bridgeport, Conn.	17	"	"	"
Morris & Cummings Dredging Co., N. Y. City	18	"	"	"
Boynton Bros., Providence, R. I.	23 50-100	"		"
Geo. C. Fobes & Co., Baltimore, Md	24	"	"	"
Augustus B. Martin, Boston, Mass., above Fields Point	33	"	"	"
At Pawtuxet	40	"	"	".

The contract was awarded to the Atlantic Dredging Co., the lowest bidder at 16 cents. This company commenced work September 24, 1879, and up to December 1, 1879, removed 85,271 cubic yards of material from that part of the Providence River above Sassafras Point, making a depth of 20 feet at mean low water.

Removal of Bulkhead Rock.

The lowest bidder at the opening of proposals for the removal of this rock, June 26, 1879, failed to enter into contract and the work was awarded to the next lowest bidder, Mr. Isaac A. Sylvester of Newton, Mass., at the price of $7,169 for the removal of the entire rock to a depth of 20 feet at mean low water. This work will be commenced in the early spring of 1880 and the rock will probably be removed to the required depth during the season.

Advance sheets from the Annual Report of the Chief of Engineers for 1879 containing my report upon the works in Rhode Island, &c., are sent herewith.

Very respectfully,

G. K. WARREN,

Lieutenant Colonel Engineers and Brevet Major-General, U. S. A.

B.

PREAMBLE AND RESOLUTION AS TO DREDGING BY CITY UNDER CONTRACT OF MARCH 2, 1878.

[Passed April 9, 1879.]

WHEREAS, The Committee on the Brook Street District, of the City of Providence, has asked for directions in regard to the dredging required under the contract of March 2, 1878, therefore

Resolved, That the City be requested to dredge to a uniform depth of twelve (12) feet at mean low water, opposite Carpenter's wharf and to make a channel of equal depth from said wharf to the present channel leading to the draw in Washington bridge, Further to dredge between the harbor line and the channel a uniform depth of twelve (12) feet at mean low water from Bower street southerly to a point seventy-five feet northerly from India street. Any further dredging, which may be required to conform to the contract will be defined hereafter. The measurement of the quantity removed may be taken in the scows by a competent person, satisfactory to the Harbor Commissioners, on the basis established by the United States Engineers. The place or places for dumping this material will be located by Harbor Commissioners on application.

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State of Rhode Island and Providence Plantations.

FIFTH ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, A. D. 1881.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1881.

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1881.

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The Commissioners,

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their fifth annual report:

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed Jedediah Williams, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

WORK WITH U. S. GOVERNMENT APPROPRIATION.

The scheme of improvement for Providence River and Narragansett Bay, projected by the Harbor Commissioners in 1877, and being executed by the United States Government, under direction of the Engineer Department, has made very satisfactory progress during the past year.

The sum of $110,000, in addition to the sum of $5,000 for the removal of Bulkhead Rock, which had been made by Congress for the continuation of this work, was increased by an appropriation of $60,000 by an act of Congress approved June 14, 1880. The estimated cost of the special work proposed by the Commissioners was $500,000, of which the sums now appropriated amount to $170,000.

The work already executed under these appropriations has secured a ship channel across the long bar of Providence harbor at least twenty feet deep at low water and 300 to 400 feet wide. The length of cut across this bar is about 7,600 feet, or nearly one and one-half miles. The least depth of water on the bar before the improvement was about fourteen feet, but even this depth was not found over a space of sufficient width and length to be available for the safe passage of vessels.

The work has also secured a channel across the Pawtuxet bar about 4,000 feet long, twenty-three feet deep at low water, and 200 feet or more in width. The least depth here was about eighteen feet.

The work yet to be done will consist mainly in widening these channels and in deepening that across the Providence Harbor bar. What has now been accomplished will enable ocean ships to come to Fox Point wharf. The coal carrying traffic feels an impulse from the improved channel accommodations, and cargoes of 2,500 tons of coal now come to the port, where the maximum cargoes brought previous to the dredging are said to have been about 1,000 tons.

The dangerous Bulkhead Rock which lifted itself into the channel between Pomham and Fuller's lights has been blasted away during the past season, and the buoy which marked its place removed. A special appropriation of $5,000 made by Congress for this was insufficient and the additional sum required was made up out of the appropriations for the main channel.

The interesting report of Gen. G. K. Warren, Lieutenat-Colonel of Engineers, in charge of the improvement of harbors and rivers on this coast, to the Chief of Engineers, U. S. A., is largely quoted in appendix A to this report, from advance sheets kindly sent to us, and we ask especial attention to the valuable information there given. We are further indebted to Gen. Warren for a resumé of operations for the improvement of Providence River after the date of his report, at the close of the fiscal year, which will also be found in the appendix.

It becomes more and more evident to us, that true economy in expenditure for dredging requires the adoption, in part at least, of the practice common in European ports, for the local authorities to own dredging and towing apparatus, and to furnish it, at moderate rates, to those who do the work.

DUMPING GROUND.

The dumping ground for material dredged under the United States Government is in deep water near Half Way Rock, east of Conanicut Island. Assent was given to dumping a small amount of dredged material on the east side of Providence Harbor, under certain restrictions, including the requirement that no dumping should be within seven hundred feet of the harbor line. Assent was also given to dumping on the west side of Providence Harbor under similar restrictions, except that the limit of distance from the harbor line for dumping was reduced to six hundred feet. It is not thought to be advisable to allow any more dumping in either of these localities until suitable retaining walls are built.

General Warren called the attention of the Board, in December, to dumping which had been done on the east side of the harbor in an objectionable position. This dumping was wholly unauthorized and was done by parties dredging near the Wilkesbarre Pier. Action will probably be taken to cause the removal of as much material as was dumped without authority. Assent was given to dumping dredged material at two points in Seekonk River, under certain restrictions. One point was on the west side between Red Bridge and Washington Bridge, not nearer the channel than 450 feet west of the harbor line. The other point was on the east side, above Walker's Point, not more than 400 feet from shore at the middle of the dumping ground. Permits for dumping at these points are not considered to be now in force.

SURVEYS AND PLANS.

Surveys have been made during the year for the establishment of certain harbor lines, and copies have been taken of several valuable plans made by the Coast Survey Department for the city of Providence. The City Engineer has made copies of plans owned by the State and in charge of the Harbor Commissioners, so that the convenience of both offices in the use of the plans is increased and the chance of their destruction by accident is lessened.

HARBOR LINES.

The harbor lines proposed to be established in Barrington River have not been determined upon because of a request for delay by the parties specially interested, and who bore the cost of the surveys. A harbor line from above Sassafras Point to below Field's Point was established by chapter 819 of the Public Laws, passed April 16, 1880. Notice has been given of the proposed establishment of harbor lines from near Field's Point to Rock Island and including the mouth of Pawtuxet River. Informal hearings have been held upon this matter and the lines will probably be submitted to the Governor and Senate during this session.

BRIDGES IN SEEKONK RIVER.

Attention has been repeatedly called to the serious nature of the obstructions to navigation in the Seekonk River, and this Board, in its last report, urged the appointment of a special commission to consider and report to the General Assembly upon the matter. Such a commission was appointed and is required to report at this session. This Board is convinced that prompt relief from the obstructions which have been deliberately placed near mouth of this river, is imperatively needed.

LICENSES, ETC.

Licenses have been issued for the construction of wharves as follows:

1. April 14, to William A. Cushman, to construct a wharf on the west side of Seekonk River below Red Bridge.

2. April 28, to Hopkins, Pomroy & Co., to repair their wharves on the west side of Providence River, above Point Street Bridge.

3. May 24, to representatives of the estate of E. Simmons to repair Simmons' Wharf, on Providence River.

4. July 13, to the Providence Waterworks for extension along the Dorrance Street Wharf in Providence.

5. November 10, to the Boston and Providence Railroad Corporation for rebuilding a portion of their wharf at India Point in Providence.

Assent, to various constructions, has been given as follows:

1. March 3, to V. V. Chace, at Sabin's Point.
2. June 2, to J. E. Buckingham, at Drownville.
3. June 2, to M. B. Sutton, at Kettle Point.
4. June 23, to R. R. Higgins & Co., at Drownville.
5. June 23, to V. V. Chace, at Pawtuxet Neck.
6. July 13, to W. H. Allin, at Bullock's Cove.
7. September 15, to E. C. Potter, at Nayatt Point.
8. December 1, to Warren Manufacturing Company, at Warren.
9. December 1, to O. Chace, in Kickamuit River.

Action has been taken to prevent unauthorized construction in other places.

Attention has been called to various encroachments upon and obstructions in the public tide waters, and action taken to prevent injurious results. Experience has shown that constant care and attention are required, on the part of the commissioners, to prevent serious injury in the harbors and channels by act or neglect of persons who might gain some advantage or be saved some trouble by such public injury.

DRAW-BRIDGES.

Complaint has more than once been made to this Board that the interests of navigation have been unnecessarily interfered with by the keeper of a draw-bridge. We respectfully suggest that inquiry be made by a suitable committee of the General Assembly as to whether further legislation is needed to regulate the times for opening draw-bridges, and as to the blocking of the approaches to draws.

SPEED OF STEAM VESSELS.

A communication from General Warren was received by the Board in May, stating that the works of improvement being prosecuted by the general government, under his direction, were constantly delayed and damaged by the various steamboats and steamships running by the work at high rates of speed, and suggesting the desirability of having the speed of all steam vessels regulated, when passing any machinery or appliances belonging to the improvement, by law. General Warren asked us to bring this matter, in proper form, before the executive and legislature of Rhode Island. The board immediately communicated with the managers of the various steam vessels plying in the river and bay, and so far as we know each and all of them gave prompt orders for the slowing of their vessels when passing any appliances of the government work. We have had no further complaint of injury.

In compliance with General Warren's request we presented the matter at the May Session of the General Assembly, and its consideration was undertaken by the House Committee on the Judiciary. No action was had at the May Session.

WORK OF THE UNITED STATES ENGINEER.

By the courtesy of General G. K. Warren, the Board has received advance sheets of his report to the Chief of Engineers upon the works under his charge in Rhode Island, for the year ending June 30, 1880, and a communication giving the progress of the Providence River improvement since June. As General Warren's report, so far as it relates to work in Rhode Island waters, is given in full in the Appendix, we refrain from making a summary here, in the hope that the whole paper will be carefully read.

UNITED STATES ADVISORY COUNCIL.

Our work during the past year has not seemed to require us to call upon the services of the Advisory Council appointed by the President. The Board is composed of Rear-Admiral Daniel Ammen, U. S. N.; Brevet Major-General G. K. Warren, U. S. A., and Prof. Henry Mitchell, U. S. C. and G. S.

Respectfully submitted,

J. HERBERT SHEDD,
N. F. POTTER,
JEDEDIAH WILLIAMS,
Harbor Commissioners.

APPENDIX.

A.

ABSTRACT FROM REPORT OF GEN. G. K. WARREN TO CHIEF OF ENGINEERS, U. S. A., FOR 1880, AND COMMUNICATION RELATIVE TO PROGRESS OF WORK IN PROVIDENCE RIVER.

Improvement of Pawtucket (Seekonk) River, Rhode Island.

DESCRIPTION OF LOCALITY.

This is an estuary forming the continuation of Providence River from Providence to Pawtucket, a distance of 5 miles, and forms a shoal tidal basin of about 1½ square miles. The navigation is seriously obstructed by a badly arranged drawbridge near its lower end at East Providence. The ruling low-water channel depth before it was improved was 5 feet. The mean rise of the tide is about 5 feet at Pawtucket. It was dredged till the ruling depth at mean low water was 7 feet, and least channel width of 75 feet.

HISTORY.

Dredging was begun (by an appropriation from the general government) in 1868, $17,000 being allotted; in 1870, $8,000 was appropriated; in 1871, $7,000; in 1872, $10,000; in 1873, $10,000; in all, $52,000. For details see Annual Report, 1874, pp. 227 to 237, Part II.

WORK DURING LAST FISCAL YEAR.

Tidal observations were made at Red Bridge, Butler Hospital, and Dunnell's Wharf in connection with those made at Providence. These places were carefully leveled between, and the high and low-water determinations are given with confidence of being very good. The State government of Rhode Island appointed a commission to examine and report on the obstructions at the bridges.

It is hoped that the work of this commission will result in giving to the navigation interests a wide passage way through this part of the river.

Accompanying this report is that of Mr. H. A. Bentley, assistant engineer, with a diagram and tide tables, giving in detail the results of the tidal investigations made, to which I invite attention.

WORK DURING THE ENSUING FISCAL YEAR.

No work is contemplated during the year, except what examinations may be necessitated into accidental obstructions, for whose removal the small sum of money left from the last appropriation is kept. No appropriation is asked for.

IMPORTANCE OF THE IMPROVEMENT.

Pawtucket is a town of about 30,000 inhabitants, largely engaged in manufactures. In 1878 there were 350 schooners and 14 barges towed up the improved channel, having a freight of about 100,000 tons.

It is in the Providence collection district, that place being the nearest port of entry. The revenue collected there in the past fiscal year in $405,652.73.

MONEY STATEMENT.

July 1, 1879.	Amount available	$1,101 80
July 1, 1880.	Amount expended during fiscal year	572 22
July 1, 1880.	Amount available	529 58

REPORT OF MR. H. A. BENTLEY, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., June 30, 1880.

GENERAL: I have the honor to submit the following report on the tides of the Pawtucket or Seekonk River, Rhode Island. This report should be taken in connection with, and as supplementary to my report to you of April 4, 1874. See Annual Report Chief Engineers for 1874, Part II, pages 229-237.

The tidal observations made then were as complete as the limited amount of money applicable to the purpose would permit of. They were particularly directed to ascertaining whether the bridges across the river were an obstruction to the tidal propagation or not. The method employed was that of simultaneous observations at different points along the river, the available money not being sufficient to permit of leveling between the gauges. The mean low water used was taken from observations made for a lunar month (April-May, 1873) at Butler Hospital Wharf, and this was transferred to other parts of the river by simultaneously observing a gauge at low-water, and assuming that it bore the same relation to mean low water that it did at Butler Hospital wharf.

In 1878 the harbor commissioners of Rhode Island had some levels run along the river, using as a datum the reference to mean low water on the west abutment of India Point Railroad Bridge, which was established there in 1874 by the United States Coast Survey, while making a survey of Providence Harbor. These levels showed a difference of elevation of mean low water between India Point Bridge and Butler Hospital Wharf of 1.35 feet.

This difference was too great for truth, and examinations were instituted to discover the error.

The following is a description of the results obtained in this connection, together with some observations on the question of the improvement of the river incident to it:

GAUGES ESTABLISHED AND LEVELED BETWEEN IN 1879.

At City Wharf, Providence.—This gauge (the same as described in report of this date on Providence River tides) is located near Point Street Bridge, but for all purposes of comparison it will be considered as being located 100 feet below India Point Railroad Bridge, observations having shown that there is no difference in either time or height between these two places. It is at India Point Bridge that the complications in the tides of the Pawtucket River arise. The gauge was placed at City Wharf for use in the Providence River observations, and was observed for the two purposes at the same time. Mean rise and fall of tide, 4.7 feet. Mean low water is referred to a bench-mark on top of west abutment of India Point Railroad Bridge. The highest point of the letter S, of the letters C. S. cut in the abutment, is 11.909 feet above mean low water.

At Red Bridge.—The gauge here is located about fifty feet above the bridge. It was observed for a lunar month. Mean rise and fall, 4.57 feet. Bench-mark northeast corner of bridge seat of west abutment of bridge is 17.132 feet above mean low water. The mean low-water at City Wharf, Providence as referred here by levels, is the same as that taken from the month's observations just referred to.

At Butler Hospital Wharf.—This gauge is on the wharf at the same place it was when taken in 1873. Observations were made for a lunar month; they gave a mean rise and fall of 4.84 feet, or 0.38 foot more than was recorded in 1873. The mean low water reference differed only 0.03 of a foot. The difference of elevation discovered by the harbor commissioners in their surveys in 1878 is accounted for by the fact that the wrong point was mistaken for the bench-mark. The bench-mark is the bottom step of the upper river face of the wing wall of bridge over road-way leading from the wharf to the hospital buildings; its elevation is 55.825 feet above mean low water of the observations of November, 1879, and 55.794 feet above that determined in 1873. Mean low-water at City Wharf, Providence, is 0.07 foot below that established here in 1879.

At Dunnell's Wharf.—This gauge is located on the wharf about 1 mile below the dam, which is just above the sudden rise of the bed of the river, which makes it the limiting point of the tidal influence, and where the river changes its name to the Blackstone. The observations were made here so that the volume of fresh water coming in from the Blackstone would not affect them so much as it would had they been taken nearer the head of the river. The mean rise and fall of tide here is 4.82 feet. Mean low water is referred to a bench-mark which is a crow-foot mark on top of most southerly pile in Dunnell's Wharf; it is 6.848 feet above mean low water; also to a bench-mark which is a vertical and horizontal crow-foot mark on thin flat stone of wall of wharf, second stone from top and 11½ feet from southwest corner of Dunnell's Wharf It is 6.821 feet above mean low water. Mean low water at Providence is 0.22 foot below that established here in November, 1879.

The following is a table of observations made at high and low water at each of the above-mentioned places; the datum line is the line of mean low water, Providence.

Date.	High Water.				Low Water.			
	City Wharf, Providence.	Red Bridge.	Butler's Hospital Wharf.	Dunnell's Wharf.	City Wharf, Providence.	Red Bridge.	Butler's Hospital Wharf.	Dunnell's Wharf.
1879.								
November 1	5.75	5·65	5.90	6.50	0.50	0.65	0.75	1.00
November 2	5.80	5.80	5.95	6.40	1.80	2.00	2.00	2.00
November 3	6.80	6.75	6.90	6.90	2.00	2.40	2.35	2.00
November 4	5.55	5.40	5.50	5.80	2.00	2.00	2.05	2.60
November 5	5.70	5.60	5.85	6.00	1.80	1.85	2.10	2.40
November 6	5.30	5.25	5.40	5.50	1.80	1.75	1.80	2.50
November 7	5 60	5.50	5.70	6.00	2.40	2.30	2.40	2.60
November 8	5.90	5.90	6.10	6.20	2.50	2.45	2.50	2.60
November 9	6.02	6.00	6.25	6.50	2.10	2.15	2.20	2 30
November 10	6.10	6.05	6.20	6.40	1.50	1.50	1.60	1.70
November 11	6.90	6.90	7.10	7.30	1.50	1.60	1.70	1.80
November 12	7.75	7.70	7.90	8.10	1.85	1.55	1.60	1.70
November 13	8.15	8.20	8.30	8.60	0.68	1.05	1.20	1.30
November 14	8.40	8.40	8.50	8.80	1.50	1.80	1.90	2.10
November 15	8.45	8.50	8.70	9.00	1.68	2.00	2.10	2.25
November 16	7.95	7.00	8.10	8.60	1.10	1.30	1.35	1.40
November 17	7.32	7.30	7.50	7.72	1.64	1.80	1.90	2.00
November 18	7.66	7.60	7.90	8.08	2.35	2.30	2.35	2.42
November 19	7.47	7.40	7.60	7.85	1.90	1.90	1.90	2.00
November 20	7.90	7.85	8.00	8.25	3.10	3.10	3.20	3.30
November 21	3.90	3.65	3.85	4.10	0.40	0.80	0.90	1.00
November 22	5.95	5.95	6.00	6.50	2.10	2.15	2.20	2.35
November 23	5.90	5.80	6.00	6.28	2.87	2.95	3.00	3.18
November 24	5.73	5.70	5.90	6.22	1.90	2.20	2.15	2.28
November 25	6.28	6.30	6.50	6.70	2.40	2.50	2.30	2.80
November 26	6.35	6.25	6.50	6.75	1.90	1.80	2.00	2.00
November 27	6.30	6.10	6.50	6.50	1.60	1.70	1.75	1.88
November 28	6.60	6.45	6.60	6.90	2.10	1.95	2.05	2.18
November 29	6.60	6.50	6.60	7.10	2.20	2.05	2.15	2.20

A study of this table shows the low tide to be generally the same as regards height at City Wharf, Providence, and Red Bridge, while at Butler Hospital Dock it is a little above, and at Dunnell's Wharf more above.

The high tides at Red Bridge are below those of City Wharf, Providence; at Butler Wharf they are above City Wharf, and still farther above at Dunnell's Wharf.

DURATION OF STAND AT LOW AND HIGH WATER.

During seven days, November 17 to 23, inclusive, careful observations of the time of stand were made at each gauge; the results are shown in the following tables:

Table of duration of stand of low-water.

Date.	India Point Bridge.	Red Bridge.	Dunnell's Wharf.
1879.	*Min.*	*Min.*	*Min.*
November 17	10	15	15
November 18	10	15	20
November 19	10	10	15
November 20	10	20	15
November 21	10	20	20
November 22	10	20	15
November 23	5	20	15

Table of duration of stand of high-water.

Date.	India Point Bridge.	Red Bridge.	Dunnell's Wharf.
1879.	*Min.*	*Min.*	*Min.*
November 17	5	30	15
November 18	5	5	5
November 19	5	10	10
November 20	5	5	15
November 21	5	25	10
November 22	5	10	5
November 23	5	15	20

The next two tables give the number of minutes elapsing between the time that low-water commenced to rise and high-water to fall, at India Point, Red Bridge, and Dunnell's Wharf.

LOW-WATER.

Date.	Red Bridge, minutes after India Point.	Dunnell's Wharf, minutes after India Point.
November 17	25	55
November 18	05	35
November 19		50
November 20	38	50
November 21	31	65
November 22	39	60
November 23	49	50
Mean	31.3	52.2

HIGH-WATER.

Date.	Red Bridge, minutes after India Point.	Dunnell's Wharf, minutes after India Point.
November 17		25
November 18	30	45
November 19	23	25
November 20	05	20
November 21	11	20
November 22		20
November 23	37	40
Mean	21.2	27.8

The direction and force of the wind on these days was as follows; 5—gale, 0—calm:

November 17	West 1.
November 18	N. E. 4.
November 19	N. W. 1.
November 20	N. E. 2 to S. W. 3.
November 21	N. W. 4.
November 22	W. 1 to S. 1.
November 23	W. 1.

DEDUCTIONS MADE FROM THESE OBSERVATIONS.

The foregoing tables show the tide falling at Providence $27\frac{8}{10}$ minutes (mean of 7 days) before it is affected at Dunnell's Wharf.

They also show the low-water to have commenced to rise 52.2 minutes earlier at Providence than at Dunnell's Wharf. The Coast Survey table of constants gives as the difference of time that the tidal-wave reaches Newport and Providence as 29 minutes, a distance of about 29 miles. If we suppose this rate to be the natural one, then the difference between Providence and Dunnell's Wharf would be but 5 minutes, or 23 minutes less than is actually the case on the falling tide, and 47 minutes less than the rising tide, but this is supposing the Seekonk River to be an unobstructed estuary of Narragansett Bay and the ocean. Very far from being unobstructed, this river at its mouth is naturally narrow and is artificially obstructed to a large extent by the foundations of the bridges. In order to ascertain, as nearly as it is practicable to do so, how much of the retardation of the tide is due to natural and how much to artificial causes, I have taken the time that elapsed at high-water, between the time it commenced to fall at Dunnell's Wharf and India Point, as indicating approximately the rate of propagation uninfluenced by the artificial obstructions. At high-water the volume of water in this basin is increased about 400 per cent., while the obstructions at the bridges are no greater than at low-water; their influence, therefore, should be but one-fourth as much at high-water, and consequently the retardation of the first of the falling tide should be proportionately less, which the observations show to be the case.

The duration of the rise at Providence (mean) is given by the Coast Survey as 7 hours 10 minutes, and of the fall 5 hours and 15 minutes, or 1 hour 55 minutes less for the fall than the rise. If the full ebb-tide has an acceleration over the flood of 1 hour and 15 minutes, the difference in time which is required for the tide to go from Providence to Pawtucket in the same proportion would be 10.1 minutes, so that if the observations show the falling tide to be 27.8 minutes in getting between the two places, 27.8 plus 10.1 should give the time of the rising tide in making the same distance. The observed time of passage of flood-tide is, however, 52.2 minutes, or 14.3 minutes in excess (38 per cent.), which may be taken as an approximate measure of the effect of the obstructions at the bridges on the rate of tidal propagation.

The following map shows the tidal basin of the river with the location of the observed gauges indicated. On the same sheet is platted a diagram of tides on which is shown the extreme and mean high and low waters referred to the datum of mean low-water, Providence.

The effect of the obstructions at the bridges may be readily seen from this diagram. In the obstructed area between Red Bridge gauge and India Point the mean low-water line is level; the high-water line of November 21 descends from India Point to Red Bridge 3 inches, and then rises to Dunnell's Wharf 6 inches; the mean high-water line descends 3 inches to Red Bridge, and then rises 6 inches to Butler Hospital and 2 inches more to Dunnell's Wharf; the extreme high-water of November 15 is level to Red Bridge, and then rises to Dunnell's Wharf 9 inches. We thus have in the cases of mean high-water and high-water of November 21 a slope extending up river in the obstructed area, while it is reversed and extends the other way or down river in that part above Red Bridge where it is open and free. In the case of extreme high-water the effect on the increased mass of water is not so apparent, and this line becomes level up to Red Bridge, and probably with a still greater body of water a uniform slope would exist throughout.

The previous deductions made in this report on the rate of propagation is confirmatory of this.

A probable mean high-water line with obstructions removed is drawn on the diagram. Assuming the slope to be uniform this would increase the height of mean high-water at Pawtucket about 0.8 foot.

EXAMINATIONS OF RHODE ISLAND HARBOR COMMISSIONERS AND OF UNITED STATES COAST SURVEY.

The Third Annual Report of the Rhode Island Harbor Commissioners contains a valuable report of examinations of the tides at Washington Bridge. Our determinations of the tides were compared with theirs; mean low-waters agree within $\frac{1}{100}$ of a foot. There are two mean low-water references at India Point Railroad Bridge established by the United States Coast Survey in connection with their survey of Providence Harbor in 1874. Our determination of mean low-water is 0.091 foot above that of the Coast Survey on the Pier of India Point Bridge, and 0.171 foot above the reference on the abutment of the same bridge. The heights of these two bench-marks are given as 10.04 and 12.08, a difference of elevation of 2.04 feet; whereas the actual difference in elevation of the two points is but 1.96 foot.

VALUE OF AN IMPROVED TIDAL WAY.

On the diagram of tides there is drawn a probable line of mean high-water with tidal obstructions removed, which gives 0.8 foot additional height at Pawtucket. To secure an additional depth of this amount by the ordinary methods of dredging would cost, at 30 cents per cubic yard, $15,000; but by far the greatest benefit to be derived from clearing the tidal way at the bridges would be in the increased facilities and safety of navigating this part of the river with a slow and even flow of current.

ACTION OF THE STATE OF RHODE ISLAND REGARDING THE DESIRED IMPROVEMENT.

A commission has lately been appointed by the State government to consider and report on the question of the improvement of the Seekonk River in the vicinity of Washington Bridge. This commission will consider the advisability of making such modifications of the bridges as to secure wide draw-spans and the removal from the bottom of the river of the existing obstructions to the tide, as well as to provide for the convenience of the rail and highway traffic.

NEW OBSTRUCTIONS.

There has been some material dumped between the Twin Islands, which will, if continued, eventuate in a serious obstruction to the flow of tide. The harbor line on the west side of this part of the river has already been established, and while it embraces a large area of the tidal basin, it would not, in all probability, cause any appreciable difference in the tide, provided the east side is not obstructed. The Twin Islands lie near the middle of the river, in the direct line between Washington and Red Bridges. The west island of the two is on the east side of the channel at the point where it makes a sharp turn. If there should be a barrier created between this island and the east shore, it would undoubtedly create a bad cross-current in the channel. The harbor line on the east side of the river here has not, to my knowledge, yet been established. It is certainly of much importance to the commerce of this river above that this line be not extended far from the shore. With wharves thrust out into the stream from both banks, a reach of river would be created that for bad currents would rival those existing at Washington Bridge. The improvement of the bridges will make pier privileges here valuable, and consequently a greater desire will be created to extend wharves into the stream.

In conclusion, I desire to recommend that the tidal determinations given in this report be adopted in preference to others previously deduced. The leveling was carefully done and checked. I have been assisted by Mr. W. H. Lawton, civil engineer, and have been kindly aided by Mr. J. Herbert Shedd, civil engineer, chairman Harbor Commission, and Mr. Samuel M. Gray, city engineer of the city of Providence. Respectfully submitted,

H. A. BENTLEY, *Assistant Engineer.*

Bvt. Maj. Gen. G. K. WARREN, *U. S. A., Lieutenant-Colonel of Engineers.*

Improvement of Providence River and Narragansett Bay, Rhode Island.

LOCALITY OF IMPROVEMENT.

Providence River is an estuary of Narragansett Bay, extending from Nayatt Point to the city of Providence. Its length is about 7 miles, with a width varying from 1,000 feet to 2 miles, and a depth in the channel varying from 12 feet to 50 feet at mean low-water, with a mean rise of tide of 4.7 feet. Near its head this estuary is joined by another, called the Seekonk or Pawtucket River, extending 5 miles farther, to the town of Pawtucket. The Providence River also contains Bulkhead Rock, for whose partial removal there is an unexpended special appropriation of $5,000. All the improvement thus far included under the title of this work is situated in the limits of Providence River, except a possible deepening upon a shoal below Nayat Point and above Rocky Point, to facilitate the navigation by means of the west entrance to the bay; it is not in the way, using the middle entrance to the bay.

HISTORY OF IMPROVEMENT PREVIOUS TO 1878.

According to the records we have, a survey was made of Providence Harbor by Lieut. Wm. S. Rosecrans, United States Engineers, under an appropriation made by the city, which was completed in March, 1853. In 1852, an appropriation of $5,000 was made, and this was expended by Capt. George Dutton, United States

Engineers, in dredging, in 1853, at the "Crook"—a bad shoal then existing just below Fox Point, and having a depth of only "4.3 feet at low-tide." The dredging was carried to 9 feet depth at low-water, over an area of 50 yards by 280 yards.

The next appropriation was $25,000, made in 1867, based on an estimate made by an assistant of the United States Coast Survey (Mr. F. P. Webber). This was expended in 1867 by Col. D. C. Houston, United States Engineers, in dredging at the locality of the "Crook," with the exception of $2,000 employed to remove a wreck opposite Sabin's Point. With this dredging a depth of 12 feet at low-water was secured up to Fox Point.

In 1870 another appropriation of $5,000 was made by Congress, which was expended under my direction at the locality of the "Crook" (which itself may be said to have been removed), and a depth of 14 feet at mean low-water secured up to the wharves at Fox Point. (For details of foregoing, see Annual Report, 1871, pp. 727–730.)

On June 10, 1872, another appropriation was made. It was $10,000, and was all expended under my direction in widening the channel just below Fox Point. A survey was made this year, as authorized by Congress, with a view to cutting off a "point of long bed," on the east side of the channel, opposite Sassafras Point. (See Annual Report for 1872, p. 820; and for 1873, pp. 968–970.)

On March 3, 1873, an appropriation of $10,000 was made, which was all expended in removing the point of long bed. (See Annual Report for 1874, pp. 237–239.) This practically completed the improvement by dredging as far as it was needed for the use of coasting vessels. The city also expended largely in deepening about the wharves.

HISTORY OF REMOVAL OF BULKHEAD ROCK.

An estimate for removing this so as to give a depth of 14 feet at mean low-water was made by Capt. A. H. Holgate, United States Engineers, in June, 1870, at a cost of $2,500. Its least depth then was 8 feet at mean low-water. A depth about that sought was secured that year by large blasts of gun-powder placed upon the rock.

In the Annual Report for 1875, p. 291, an estimate was submitted to increase the depth to 18 feet at mean low-water, requiring an appropriation of $5,000. This was renewed in the Annual Report for 1876, part I., pp. 207, 208; and again in the Annual Report for 1877, part I., p. 199.

On June 18, 1878, an appropriation of $5,000 was made for removing this rock, but operations upon it were reserved for the reason that the new plan requires greater depth. (Annual Report for 1878, part I., p. 232, par. 3.)

HISTORY OF THE IMPROVEMENT FOR LARGE SEA-GOING VESSELS.

This is given in detail in the Annual Report, 1878 (Part I., pp. 231–241) up to the beginning of the present fiscal year. In brief, this improvement was designed at first by the Board of Harbor Commissioners of Rhode Island, with a view to obtaining a free channel-way from Providence to the ocean, having a depth of 23 feet at mean low-water and least width of 400 feet, besides an enlarged basin for anchorage of a somewhat less depth, shoaling up to 10 feet at an extreme width of 800 feet. This was to cost, in round numbers, $500,000. The plan was submitted to an advisory council, appointed, by request, by the President of the United States, of which Rear-Admiral Daniel Ammen was chairman. This council changed the plan somewhat, so as to make the 23-feet mean low-water channel only 150 wide, gradually shoaling to 12 feet on an extreme width of 940 feet, and to 6 feet at an extreme width of 1,060 feet; the channel way to be symmetrical in cross-section, with the greatest depth in the middle. This was also estimated to cost about $500,000. After being memorialized Congress referred the matter to the War Department for a report, which was made by myself. I submitted an estimate for work during the next fiscal year of $100,000, to make a channel 23 feet deep at mean low-water 200 feet wide, to at once open the harbor to ocean steamers to the greatest depth proposed, leaving the widening to be a subsequent matter. Congress, however, appropriated only $50,000 for this purpose. The interests of Providence, as represented by some of the most prominent public and business men, it was thought, in view of the amount appropriated, would be best served by commencing the center line of the new channel at a depth of 20 feet at mean low-water, and carrying it through between Fox Point and Field's Point to a width as great as the money would allow. This latter course was adopted by the Engineer Department.

Advertisements were issued August 5, 1878, for bids for dredging, and the work was awarded to Mr. E. R. Seward, of Albany, New York, at 11¼ cents per cubic yard. The work was commenced October 5, 1878, and continued up to December 25, 1878, when the contractor abandoned it. Under this contract there was removed 73,314 cubic yards of mud from the part of the river between Sassafras and Fox Points, making a depth of 20 feet at mean low-water.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1880.

By act of Congress approved March 3, 1879, an appropriation of $60,000 was made for continuing this work. This money was made available July 30, 1879, and proposals for dredging under it and the money left from the appropriation of June 18, 1878 (the work having been abandoned by the contractor,) were received August 26, 1879.

The following is the abstract of proposals received:

Number.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	Atlantic Dredging Company, Brooklyn, N. Y. ..	$0 16		
2	H. N. & A. J. Beardsley, Bridgeport, Conn.	17	Sept. 15, 1879	
3	Morris & Cummings Dredging Company, N. Y.	18	Sept. 20, 1879	Sept. 1, 1880
4	Boynton Bros., Providence, R. I.	23.50		
5	Geo. C. Fobes & Co., Baltimore, Md........,..	24		
6	Augustus B. Martin, Boston, Mass.............	*33 †40		

*Above Field's Point. †At Pawtucket..

The work was awarded to the Atlantic Dredging Company, the lowest bidders, and they commenced work September 26, 1879, and are prosecuting it at this date, June 30, 1880. The time of completion is December 1, 1880. The greater part of the work done has been between Field's Point and Fox Point, where a channel has been made having a least width of 200 feet and a depth of 20 feet at mean low-water. In addition to this, two cuts have been made through Pawtuxet Shoal, making a width of 70 feet and depth of 23 feet at mean low-water. The total number of cubic yards removed, under this contract, is 327,559, all of which has been dumped in the deep water near Half Way Rock.

BULKHEAD ROCK.

This rock, as before stated, was removed to about 14 feet depth, under an appropriation of $2,500 made in 1870. The line of the east side of the proposed channel, by the new plan of improvement, extends east of the rock, and to make the required width and depth at this point requires a depth of 20 feet at mean low-water on Bulkhead Rock. Advertisements were issued for doing this under date of May 30, 1879, and the following bids were received:

Abstract of proposals received at the Engineer Office, U. S. A., June 26, 1879, at 12 m., for the removal of Bulkhead Rock, Providence River, R. I., to a depth of 20 feet at mean low-water.

Name and address of bidder,	Price.	Commence.	Complete.	Remarks.
David V. Howell, Savannah, Ga	$3,922 00	Sept. 1, 1879	June 30, 1880.	Bid informal.
Isaac A. Sylvester, Newton, Mass	7,169 00		June 30, 1880.	
Geo. W. Townsend, 214 Atlantic ave, Boston, Mass	7,860 00		June 30, 1880.	

The lowest bidder, Mr. D. V. Howell, having failed to furnish bonds or enter into contract, the work was, by authority from the Engineer Department, awarded to the next lowest bidder, Mr. Isaac A. Sylvester. The contractor commenced work March 8, 1880, and is still engaged on it. By the terms of contract no payment is to be made for the work until the entire rock is removed to a depthof 20 feet at mean low-water.

THE PROBABLE OPERATIONS DURING THE NEXT FISCAL YEAR

Will be the continuation of the work of dredging to a depth of 20 feet at mean low-water above Field's Point, and the completion of the removal of Bulkhead Rock to 20 feet depth at mean low-water.

The amount of money estimated necessary to complete this improvement is $330,000, of which $100,000 could be expended judiciously during the next fiscal year.

IMPORTANCE OF THE IMPROVEMENT.

Providence is a city of about 100,000 inhabitants and is the second city in size and importance in New England. It is a manufacturing city of importance.

Large quantities of arms of war are made here. It is a very convenient distributing point, and its fine approaches from the ocean will give it a large opportunity for foreign trade as soon as the contemplated deep channel is secured.

The total number of vessels that arrived at the port of Providence during the year 1878 was 5,580, of which 1,975 were steamers from Baltimore, Philadelphia, New York, Fall River and Newport; 3,440 were barks, brigs, schooners, sloops and barges, from various American ports, and 112 foreign barks, brigs and schooners. Providence is in the Providence collection district, and that place is a port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1880, was $405,652.73.

TIDAL OBSERVATIONS MADE IN OCTOBER AND NOVEMBER, 1879.

With this report is submitted an account of tidal observations made by Mr. H. A. Bentley, assistant engineer, who has superintended the works of improvement.

The mean rise and fall of tides here is given on the Coast Survey charts as 5.1 feet. A mean of three and a half years' observations of a self-registering gauge gave it as 4.53 feet. The former is known to be excessive and the latter was thought to be too small. Our observations of 1879 prove this to be so and make the mean rise and fall 4.7 feet, the determinations agreeing very closely with those made in 1853 by Lieut. W. S. Rosecrans, United States Engineers. Mr. Bentley's report is a valuable contribution to this subject, and shows the caution that is required in accepting local data about tides.

MONEY STATEMENT.

Improvement of Providence River aud Narragansett Bay.

July 1, 1879, amount available	$98,635 69	
Amount appropriated by act approved June 14, 1880	60,000 00	
		$158,635 69
July 1, 1880, amount expended during fiscal year	51,225 10	
July 1, 1880, outstanding liabilities	5,240 93	
		56,466 03
July 1, 1880, amount available		102,169 66
Amount (estimated) required for completion of existing project		330,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1882		100,000 00

Improvement of Providence River—Removal of Bulkhead Rock.

July 1, 1879, amount available	$4,994 80
July 1, 1880, amount expended during fiscal year	252 67
July 1, 1880, amount available	$4,742 13

REPORT OF MR. H. A. BENTLEY, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., June —, 1880.

GENERAL: I have the honor to submit herewith the following report on the tides of the Providence River, Rhode Island:

The first tidal observations here of which we have record are those made by Lieut. (General) W. S. Rosecrans, Corps of Engineers, U. S. A., who, in December, 1852, established a gauge, which was observed from December 11 to 17, 1852, and from April 12 to May 31, 1853. The mean of these readings, 94 of high and 90 of low-water, would make the rise and fall 4.66. Extreme range between lowest low-water and highest high-water, 7.61 feet. Mean high-water on gauge read 5.85; mean low-water, 1.19; highest high tide, 7.88; lowest low tide, 0.27. Both day and night tides were taken. A note on the record states that the zero of this guage corresponds with the low-water reference of Cushings chart of Providence Harbor. A better mean range of tide can be obtained by taking from these observations those of a lunation and deducing it from that. Using the lunar month between April 15 and May 13, inclusive, the mean rise and fall is 4.62.

The subjoined is a table of the observations of Lieutenant Rosecrans in 1853. Those made in 1852 were for seven days only, and were interrupted so that they are of little or no value and they are not given.

Record of tide gauge kept at Providence, R. I., from April 12, 1853, to May 31, 1853, under the direction of Lieut. W. S. Rosecrans, United States Engineer.

DATE.	Low-water.		High-water.	
	Time.	Height.	Time.	Height.
1853.		*Feet.*		*Feet.*
April 12	....	....	11.10 a. m.	5.52
	4.20 p. m.	1.31	11.30 p. m.	4.32
April 13	4.00 p. m.	1.00	11.50 a. m.	4.05
April 14	....	....	12.20 a. m.	4.40
	5.15 p. m.	1.60	12.00 p. m.	5.26
	5.15 a. m.	1.93	....	....
April 15	6.10 p. m.	1.78	1.35 p. m.	4.96
April 16	6.05 a. m.	1.62	1.00 a. m.	4.40
	6.50 p. m.	1.68	2.25 p. m.	4.28
April 17	7.20 a. m.	1.89	1.35 a. m.	4.74
	8.20 p. m.	2.23	3.05 p. m.	5.10
April 18	9.00 a. m.	2.15	2.45 a. m.	4.70
	9.30 p. m.	2.02	3.50 p. m.	5.35
April 19	9.40 a. m.	1.74	3.30 a. m.	5.34
	10.40 p. m.	2.12	4.40 p. m.	6.03
April 20	10.50 a. m.	1.64	4.40 a. m.	5.57
	11.10 p. m.	1.08	5.45 p. m.	5.90
April 21	12.00 a. m.	0.69	6.05 a. m.	5.78
	....	....	6.30 p. m.	6.80
April 22	12.25 a. m.	0.88	7.00 a. m.	6.67
	12.55 p. m.	0.65	7.40 p. m.	7.88
April 23	1.20 a. m.	0.98	7.40 a. m.	6.40
	1.50 p. m.	0.21	8.20 p. m.	7.42
April 24	2.25 a. m.	0.27	8.50 a. m.	6.38
	2.10 p. m.	0.20	9.15 p. m.	7.38
	3.30 a. m.	0.00	....	....
April 25	2.35 p. m.	0.05	9.45 a. m.	6.70
April 26	4.20 a. m.	0.25	10.15 a. m.	6.73
	8.40 p. m.	0.32	10.45 p. m.	7.20
April 27	5.00 a. m.	1.05	11.00 a. m.	6.25
	4.15 p. m.	1.09	11.50 p. m.	6.55
	5.45 a. m.	1.27	....	....

DATE.	Low-water.		High-water.	
	Time.	Height.	Time.	Height.
1853.		*Feet.*		*Feet.*
April 28.	5.15 p. m..	1.40	12.20 p. m..	6.00
April 29	6.05 a. m..	1.70	1.20 a. m..	6.30
	6.45 p. m..	1.85	1.25 p. m..	5.82
April 30.	7.05 a. m..	1.18	2 05 a. m..	6.47
	8.20 p. m..	2.02	2.10 p. m..	5.61
May 1.	8.30 a. m..	1.28	3.10 a. m..	5.75
	....	....	3.50 p. m..	4.78
May 2.	9.40 a. m..	0.70	4.00 a. m..	4.85
	10.30 p. m..	1.41	5.00 p. m..	5.58
May 3.	10.15 a. m..	1.10	5.15 a. m..	4.75
	11.45 p. m..	1.65	5.50 p. m..	5.93
May 4.	11 30 a. m..	1.02	5.50 a m..	5.93
	....	....	6.10 p. m..	5.85
May 5.	12.55 a. m..	1.42	6.30 a. m..	5.78
	12.45 p. m..	1.52	7.00 p. m..	6.28
May 6.	....	....	7.30 a. m..	5.42
	12.15 p. m..	0.64	7.20 p. m..	6 31
May 7.	1.30 a. m..	1.61	8.15 a. m..	5.92
	1.20 p. m..	1 82	8.20 p. m..	6.58
May 8.	....	....	8.00 a. m..	5 75
	2.15 p. m..	1.48	8.30 p. m..	6.78
May 9.	2.15 a. m..	1.22	9 00 a. m..	5 98
	2.00 p. m..	1.07	9.45 p. m..	6.06
May 10.	3.30 a. m..	1.44	10.00 a. m..	5.78
	3.00 p. m..	1.74	10 30 p. m..	6.06
May 11.	4.15 a. m..	1.35	10.45 a. m..	5.54
	4.00 p. m..	1.18	11.00 p. m..	5.22
May 12.	5.00 a. m..	0.89	11.00 a. m..	5.27
	4.15 p. m..	1.73	11.00 p. m..	5.64
May 13.	5.10 a. m..	1.35	11.30 a. m..	4.74
	4.30 p. m..	1.33	11.30 p. m..	5.49
May 14.	5.30 a. m..	1.45	....	....
	6.00 p. m..	1.47	12.30 p. m..	4.72
May 15.	6.15 a. m..	1.55	12.15 a. m..	4.60
	6.20 p. m..	1.75	1.15 p. m..	5.10
May 16.	7.25 a. m..	1.55	1.30 a. m..	5.27
	7.45 p. m..	1.59	2.50 p. m..	5.08
May 17.	8.15 a. m..	1.08	2.25 a. m..	4 96
	9.00 p. m..	1.52	3.15 p. m..	5.00
May 18.	9.00 a. m..	1.05	3.15 a. m..	5.02
	10.30 p. m..	1.54	4.20 p. m..	5.37
May 19.	10.30 a. m..	1.61	4.20 a. m..	5.49
	11.20 p. m..	0.70	5.30 p. m..	6.88
May 20.	11.15 a. m..	0.00	6.00 a. m..	6 01
	12.00 p. m..	0.10	6.10 p. m..	6.32
May 21.	12.00 a. m..	0.47	6.15 a. m..	5.78
	....	......	6.50 p. m..	7.38
May 22.	1.00 a. m..	0.70	7.30 a. m..	6.60
	1.00 p. m..	0.30	8.00 p. m..	7.57
May 23.	2.00 a. m..	0.71	8 15 a. m..	6.77
	2.00 p. m..	0.58	8.50 p. m..	7.50
May 24.	3.00 a. m..	0.47	8 45 a. m..	6 48
	2.40 p. m..	0.43	9.40 p. m..	7.20
May 25.	4.10 a. m..	0.80	9.40 a. m..	6.70
	3.35 p. m..	0.70	10.45 p. m..	6.65
May 26.	5.00 a. m..	0.87	10.30 a. m..	6.42
	4.35 p. m..	1.28	11.30 p. m..	6.71
May 27.	5.35 a. m..	1.50	11.45 a. m..	5.99
	5.40 p. m..	1.82	....	....
May 28.	6.10 a. m..	1.49	12.15 a. m..	5.62
	6.30 p. m..	1.85	12.30 p. m..	6.01
May 29.	7.00 a. m..	1.85	1.10 a. m..	6.20
	7.30 p. m..	1.10	1.10 p. m..	5.92
May 30.	7.50 a. m..	1.86	2.00 a. m..	5.62
	9.00 p. m..	2.20	3 00 p. m..	6.10
May 31.	9.00 a. m..	0.85	3.00 a. m..	5 45
	....	....	3.45 p. m.	5.43

The mean high-water plane of these observations was adopted as the city reference by Providence. In 1872 a survey of the Providence River between Fox Point and Field's Point was ordered by Congress and was made under your direction by me. At this time the city of Providence had borrowed from the United States Coast Survey a self-registering tide-gauge; this was running very well, and the city official in charge permitted us to take the record of this gauge for the lunation August 4–31, 1872, for the purpose of getting a mean low-water plane to refer the soundings of the survey to. These readings gave the mean rise and fall 4.63 feet. In 1873, while making a survey of the Pawtucket River, the readings of this gauge from May 22 to December 28 were taken, and the mean rise and fall for this period was computed to be 4.548 feet. This gauge is still at Providence, and has been most of the time in running order. A mean taken of three and one-half years of the best of these observations gave a rise and fall of 4.53.

The mean rise and fall given on the Coast survey charts is 5.1 feet. The self-registering gauge was at first located on the gas company's wharf; it was changed to Hill's Wharf, and then to its present location on the city wharf. These changes of position, and the varying difference between the registering scale and the tide-staff used for comparison made our attempts to arrive at a definite point for mean low-water very unsatisfactory.

To settle this point, and to be enabled to decide which of the above given ranges of tide was the best, the observations of which the following table shows the results were made:

Record of tide gauge kept at City Wharf, Providence, R. I., from October 3, to November 29, 1879.

Date.	High-water.	Low-water.	Date.	High-water.	Low-water.
1879.	*Feet.*	*Feet.*	1879.	*Feet.*	*Feet.*
October 3	10.30	5.10	November 1	9.15	3.90
4	9.30	5.54	2	9.20	5.20
5	10.00	6.15	3	10.20	5.40
6	9.40	5.63	4	8.95	6.40
7	9.15	6.70	5	9.10	5.20
8	8.85	5.90	6	8.70	5.18
9	9.50	6.20	7	9.00	5.78
10	9.85	6.32	8	9.30	5.90
11	10.10	6.58	9	9.42	5.50
12	10.30	5.95	10	9.50	4.90
13	11.00	5.50	11	10.30	4.90
14	11.25	4.45	12	11.15	4.75
15	11.70	4.50	13	11.55	4.08
16	11.90	4.80	14	11.80	4.90
17	12.00	5.05	15	11.85	5.08
18	11.82	5.88	16	11.35	4.50
19	11.30	4.50	17	10.72	5.04
20	10.56	5.45	18	11.06	5.75
21	10.30	5.68	19	10.87	6.30
22	10.40	5.50	20	11.30	5.41
23	10.10	7.30	21	7 30	3.87
24	9.00	4.60	22	9.35	5.50
25	8 90	4.40	23	9.30	6.27
26	9.40	4.58	24	9.18	5.32
27	9.25	4.80	25	9.68	5.85
28	10.40	7.30	26	9.75	5.35
29	9.50	3.80	27	9 75	5.00
30	9.95	4.78	28	10.00	5.50
31	9.42	4.45	29	10.04	5.60
			Mean	10.06	5.33
			Mean rise and fall, 4.73.		

The mean rise and fall of these two months is 4.78; mean low water on the staff, 5.33; mean high-water, 10.06. This staff gauge is a plain board, graduated to feet and tenths; it is located at the city wharf, a few feet distant from the self-registering gauge; it was carefully observed each day, the night tides being omitted. The self-registering gauge was "running" at this same time, and through the kindness of Mr. Samuel M. Gray, city engineer of Providence, we have been furnished with a copy of the record. For the purpose of comparison, the following diagram of the tidal zone for the month of November, 1879, was made. On this diagram is shown the recorded heights of both gauges at high and low tide for each day of a lunation. The dotted lines indicate the lines of the staff gauge, and the full lines those of the self-register. They were platted by using as a common line the line of mean level.

The diagram shows the line representing the staff-readings at high tide to be generally above the line representing the self-register; and in the case of low-tide, the staff-line to be generally below the self-register. This difference, at high tide varying between 0.05 of a foot and 0.35 foot, and at low tide between 0.05 and 0.5 foot, indicates that this self-registering tide-gauge does not record the full rise and fall. The difference in the mean rise and fall for this lunation was 0.11 foot. Whether this difference is a constant quantity caused by frictional or other resistance in the running gear of the self-registering gauge, our observations are not extended enough to decide, but we have two lunar-months of readings actually observed and one month's observations made in the same way by Lieutenant Rosecrans in 1853, both of which give a greater rise and fall than the mean of the self-register. I would therefore recommend that the range of tide indicated by our observations in October and November, 1879, be adopted, and that the mean rise and fall be taken as 4.7. Mean low-water is referred to a bench mark which is the top of the southeast corner of the west abutment of the Point Street bridge; its height is 12.29 feet. A comparison with the city reference (Rosecrans' high-water) shows a difference of but 0.01 foot, so that for all purposes this reference may be considered correct and mean low-water taken as 4.7 feet below it.

Very respectfully,

H. A. BENTLEY,

Assistant Engineer.

Bvt. Maj. Gen. G. K. Warren, U. S. A.

Lieutenant-Colonel Engineers.

Improvement of Block Island Harbor, Rhode Island.

The improvement of this harbor as projected was completed during the fiscal year ending June 30, 1879, and was so reported in the annual report for that year.

A resolution of the House of Representatives, February, 1880, was passed, calling for "information concerning the obstructions at the entrance to the inner harbor at Block Island, Rhode Island, together with an estimate of the cost of removing the same, and of otherwise placing the harbor in proper condition to answer the requirements of commerce." This was referred to me, through the Chief of Engineers, for report, under date March 15, 1880. My report, accompanied by one in greater detail by Assistant Engineer J. P. Cotton, is appended. Congress, by act approved June 14, 1880, appropriated $6,000 for this work. While this is not the full amount estimated, it will probably accomplish all that is at present needed.

MONEY STATEMENT.

July 1, 1879, amount available	$345 58	
Amount appropriated by act approved June 14, 1880	6,000 00	
		$6,345 53
July 1, 1880, amount expended during fiscal year		345 53
July 1, 1880, amount available		$6,000 00

Special Report.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., March 15, 1880.

GENERAL:—In obedience to your instruction of March 11, 1880, transmitting a resolution of the House of Representatives of the United States in regard to the obstructions of the entrance to the "inner harbor" at Block Island, Rhode Island, I have the honor to submit the accompanying report prepared by Assistant engineer J. P. Cotton.

This report has been prepared from maps and records in this office and upon the information obtained by consultation with the petitioners for the improvements.

The report gives a description of the "inner harbor," with a sketch of inner and outer harbors. This work has increased in importance until the depth of 7 feet made in 1873, and then thought sufficient, has become too small to accommodate the vessels running there.

The estimate to make 9 feet depth at mean low-water in the "inner" harbor and in the entrance thereto, and to remove the wreck, is $8,000.

Block Island is in the Newport collection district. The amount of revenue collected there in the year ending June 30, 1879, was $1,811.01.

Respectfully submitted,

G. K. WARREN, *Lieut.-Col. Engineers,*
Bvt. Maj. Gen. U. S. A.

Bvt. Maj. Gen. H. G. WRIGHT,
Brig. Gen. and Chief of Engineers, U. S. A.

REPORT OF MR. J. P. COTTON, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., March 15, 1880.

GENERAL:—I have the honor to submit the following report on the nature of "the obstructions to the entrance to the 'inner harbor' at Block Island, with an estimate of the cost of removing the same and of otherwise placing said harbor in proper condition to answer the requirements of commerce."

The harbor at Block Island is wholly an artificial one, being the area sheltered by the breakwater. When the work of constructing this breakwater was commenced in 1870, it was found that with no landing and no safe harbor within 25 miles there would be much delay and expense in building it. So great was the dread of Block Island among vessel owners and officers that it was difficult to find one that would freight stone there.

In view of this and the necessity for shelter for a crane-boat, pile-driver, and scows to be used on the work, authority was obtained by Gen. Warren to build a small inclosed harbor in the sheltered angle of the shore and breakwater. This harbor, which is referred to in the resolution calling for this report as the "inner harbor," is inclosed by a timber crib filled with stone. It is about 250 feet by 250 feet, with an opening of 60 feet in width. This enclosed area was dredged to 7 feet depth at mean low-water, which with the mean rise of the tide of 3 feet gave a depth of 10 feet at mean high water. The anchorage sheltered by the breakwater outside of this is called the "outer harbor."

The following sketch shows the relative location and extent of the outer and inner harbors of Block Island, Rhode Island.

Prior to the construction of these harbors the boats used here were small open boats that could be hauled up on the shore on the approach of storm. Upon the completion of the "inner harbor" they abandoned their old landing and occupied it, and as soon as its stability had been tested by one winter's storms they began to use larger boats, and now there are five or six sloops and schooners owned here.

When the "inner harbor" was built 7 feet depth was sufficient for such vessels as were used at the island or that were thought likely to seek it, but since there has been a harbor there, secure at all times, so that regular communication can be kept up with the main land, the island has come into prominence as a summer resort. In place of an open sailboat, carrying the mail and passengers once a week to and from the main land, they have a tri-weekly mail by a schooner of 40 or 50 tons burden, and in the summer a daily mail by steamer.

A steamer is being built to run regularly between the island and the mainland. A line of steamers, forming part of a "fast line" from New York, is to touch here on their way from Greenport, Long Island, to Newport, R. I. For these steamers and others seeking the harbor a greater depth than 7 feet is required.

The obstructions to the entrance to the inner harbor are—

First. The hull of a schooner of about thirty or forty tons that lies near the northwest corner of the Fall River Iron Works Company's wharf. This schooner dragged her anchor and came ashore here in August, 1879, and sank. She was stripped and abandoned. She is covered at high-water, and, being in the track of vessels entering and leaving the "inner harbor," is a dangerous obstruction.

Second. The depth of 7 feet at mean low-water, made in 1873, has been somewhat diminished by silting up and by the sand blown from the "sand breach" over the cribwork. The depth outside the opening has been decreased by a deposit of sand that extends from within a few hundred feet of the breakwater to the opening of the "inner harbor." Outside to the northward of the wharf of the Fall River Iron Company this sand is near the breakwater. As you approach the "inner harbor" it is spread out and covers the bottom over a great part of the entrance to the "inner harbor." The amount of shoaling here is not great, probably not more than half a foot in the opening and 2 feet in front of the Iron Company's wharf.

In the petition asking the removal of these obstructions they ask that the "inner harbor" and entrance thereto be dredged so that vessels drawing 9 feet can enter at ordinary low-water.

ESTIMATES.

For removing wreck of schooner near Fall River Iron Company's wharf	$200 00
For dredging the inner harbor and entrance thereto to 9 feet depth at mean low-water 14,000 cubic yards of clay, pebbles, and sand, at 50 cents	7,000 00
Add for contingencies	800 00
Total	$8,000 00

The price placed upon the dredging is based upon the cost of that done in 1873. The amount is small and the material hard, and will be likely to cost fully 50 cents per cubic yard.

Respectfully submitted.

Your obedient servant,

JOS. P. COTTON, *Assistant Engineer.*

Bvt. Maj. Gen. G. K. Warren, U. S. A.,

Lieutenant-Colonel of Engineers.

Improvement of Little Narragansett Bay, Rhode Island and Connecticut.

LOCALITY OF IMPROVEMENT.

Little Narragansett Bay is at the mouth of Pawcatuck River, and is between Stonington and Watch Hill. It is separated from the ocean by a narrow sand beach extending from Watch Hill toward Stonington, a distance of about 3 miles, leaving an opening between its end and Stonington of about 1 mile. The water in this bay is shoal; 4½ feet at mean low-water is the greatest depth that can be carried across it. The Pawcatuck River, navigable to Westerly, a distance about 5 miles from its mouth, can only be approached through this bay; this river has been improved by the general government under my direction so that there is now a channel 75 feet wide and 5½ feet deep at mean low-water up to Westerly. The mean rise of the tide is about 2.6 feet.

HISTORY OF PREVIOUS IMPROVEMENT.

The river and harbor act of March 3, 1875, directed a survey of this bay, which was made during the summer of 1875, and reported on November 30, 1875. (See Annual Report for 1876, part I., pp. 217 *et seq.*) The improvement recommended in this report was for a channel 200 feet wide and 7½ deep at mean low-water, extending across the north shore of the bay from Pawcatuck Point to the deep water near the mouth of the bay opposite Sandy Point, and the removal of dangerous rocks in the channel near Rhodes' Folly and Watch Hill. The estimated cost of this improvement was $51,000.

Congress, by act of August 14, 1876, appropriated $5,000 for the work. This money was expended in removing the rocks near Rhodes' Folly, and to dredging and removing rocks from the east end of the proposed channel at Pawcatuck Point.

By act of Congress, approved June 18, 1878, an appropriation of $10,000 was made for the continuation of the work. The money was expended at Pawcatuck Point, and completed a channel here 185 feet wide and 7½ feet deep at mean low-water.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1880.

An appropriation of $5,000 was made by act of Congress, approved March 3, 1879—available July 30, 1879. Proposals for dredging were invited under this appropriation, and the following is an abstract of those received:

Abstract of proposals received at the Engineer Office, United States Army, Newport, R. I., Tuesday, August 26, 1879, at 12 m., for excavating in Little Narragansett Bay, Rhode Island and Connecticut.

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	John McDermott, Cohoes, N. Y.	$0 23⅛	....	June 30, 1880
2	S. A. Hammond, Bridgeport, Conn.	44	April 1, 1880	June 30, 1880

The work was awarded to the lowest bidder, and the dredging commenced April 1 and completed May 20. There were 17,935 cubic yards of sand, mud and shells removed, connecting the channel at Pawcatuck Point, previously made, by a cut 40 feet in width and 7½ feet deep at mean low-water, with the deep water on the west side of the bay. This cut is too narrow to be of much practical use to vessels, but it demonstrates, what had already been surmised, that the only difficult part of this improvement was at the shoal at Pawcatuck Point.

This improvement has been under the superintendence of Mr. H. A. Bentley, assistant engineer.

PROBABLE OPERATIONS DURING THE NEXT FISCAL YEAR.

The act of Congress approved June 14, 1880, appropriates $5,000 for continuing the work. It is proposed to expend this in widening the cuts made last year. The amount of money estimated as being necessary to complete the improvement is $26,000, and this amount can be judiciously expended in the next fiscal year.

IMPORTANCE OF THE IMPROVEMENT.

The places that will be benefited by this improvement are Westerly and Watch Hill. Westerly is a manufacturing village on the Pawcatuck River. It has fine stone quarries and is, generally, a thriving town. The full value of the improvement of the Pawcatuck River made by the general government cannot be realized until the projected improvement in the bay is completed. This improvement will also be of the greatest value to Watch Hill, which has its only landing in the bay. Watch Hill is a popular summer resort where 45,000 passengers were landed from the steamboats during the past year.

The number of vessels taken through Little Narragansett Bay during the year 1878 was 205. There were 31 vessels drawing too much water to cross the bay that were lightered at Stonington and their cargoes taken to Westerly.

Little Narragansett Bay is in the collection-districts of Providence and Stonington; the latter is the nearest port of entry. The revenue collected during the fiscal year ending June 30, 1879, was: Providence, $405,652.73; Stonington, $1,796.84.

Money Statement.

July 1, 1879, amount available	$6,693 97	
Amount appropriated by act approved June 14, 1880	5,000 00	
		$11,693 97
July 1, 1880, amount expended during fiscal year		6,492 55
July 1, 1880, amount available		$5,201 42
Amount (estimated) required for completion of existing project		$26,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1882		26,000 00

COMMUNICATION FROM GEN. G. K. WARREN.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., March 3, 1881.

J. HERBERT SHEDD, ESQ.,
Chairman Harbor Commissioners State of R. I.,
Providence, R. I.,

SIR:

Your letter of the 1st inst., asking for a resumé of operations on Providence River subsequent to June 30, 1880, is received. At the date, June 30, 1880, the work accomplished had made a channel through Pawtuxet Shoal 70 feet wide and 23 feet deep at mean low-water; and 200 feet wide and 20 feet deep between Field's Point and Fox Point. Between that time and January 1, 1881, the width of the channel through Pawtuxet Shoal had been increased from 70 to 200 feet, and above Field's Point from 200 to 330 feet. The work done up to January 1, 1881, was paid for from the appropriations of June 18, 1878, of $50,000, and March 3, 1879, $60,000. The contractors were: The Atlantic Dredging Co.; and the price paid was 16 cents per cubic yard. By act of Congress, approved June 14, 1880, a further appropriation of $60,000 was made for this improvement. The following proposals for excavating under this appropriation were received and opened August 14, 1880:

Atlantic Dredging Company	16¾	cents per cubic yard.
William Flannery	18¼	" " " "
Frank Pidgeon	18¼	" " " "
Jesse & Lyman Boynton	19	" " " "

The contract was awarded to the lowest bidders: The Atlantic Dredging Co., of Brooklyn, N. Y. The Atlantic Dredging Co. completed their first contract January 1st, 1881, when the work of dredging was suspended on account of the ice in the river. It is expected that work on the new contract will be commenced on or about March 1st, 1881.

Bulkhead Rock.—June 30, 1880. The work of removing this rock was reported in progress. The contractor completed the removal to a depth of 20 feet at mean low-water October 14, 1880; 794½ tons of rock were removed.

The copies of my report for the fiscal year ending June 30, 1880, with the accompanying diagrams, have not yet been received.

Very respectfully,

G. K. WARREN,
Lieut.-Col. Engineers and Bvt. Maj.-Gen. U. S. A.

Eng 10/0.

State of Rhode Island and Providence Plantations.

SIXTH ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1882.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1882.

State of Rhode Island and Providence Plantations.

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1882.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their sixth annual report:

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, appointed Lucius B. Darling as Harbor Commissioner for a term of three years, to succeed Nathaniel F. Potter whose term of service expired in June.

WORK WITH U. S. GOVERNMENT APPROPRIATION.

The improvement of Providence River and Narragansett Bay, carried on by the United States Government under direction of the Engineer Department, was resumed for the season on March 8, 1881, and has been continued quite through the year with very satisfactory results.

The special work now proceeding was estimated by the Harbor Commissioners to cost $500,000. The first appropriation for it was made by Congress in June 1878, and an additional appropriation has been made each year since. By act approved March 3, 1881, Congress appropriated $60,000, for continuing the work, making an entire appropriation thus far, of $230,000.

Ocean-going steamers of the heavy class may now come into our inner harbor, but local dredging is required to enable them to reach and lie at our wharves.

The report of Gen. G. K. Warren, Lieutenant-Colonel of Engineers in charge of the improvement of harbors and rivers on this section of the coast, to the Chief of Engineers, U. S. A., is largely quoted in the appendix to this report.

We renew our suggestion that a great advantage would probably result from the adoption of the plan so largely followed in Europe, in regard to dredging and towing apparatus, where substantial plant is owned by the local authorities and let at moderate rates to those who do the work. In this way the number of competent bidders may be greatly increased and lower rates obtained.

DUMPING GROUNDS.

The dumping ground for material dredged under the United States Government is in deep water near Half-way Rock, east of Conanicut Island. We regard the dumping here as quite unobjectionable, but some opposition has been made to it and a petition for interference by the General Assembly was considered by the House Judiciary Committee in March last. The petitioners were, however, given leave to withdraw. Assent was given to dumping on their land near Public street by the Providence Gas Company. Conditional assent to dumping near the shores of Potowomut Neck was given, but the conditions were not complied with. Conditional assent was given to dumping below Bucklin's Island in Pawtucket river.

Assent was withheld upon an application to designate "Sheep Pen Cove," near Prudence Island, as a dumping ground. Printed notices were issued and distributed calling the attention of inhabitants along the Blackstone to the laws against allowing material to be deposited in that river. It has been necessary to renew the caution to steamboat owners against dumping ashes in the harbor or channels. The need for regulating and controlling the matter of dumping in public waters, is constantly apparent.

HARBOR LINES.

A harbor line from Field's Point to Rock Island and including the mouth of Pawtuxet river was designed by the Harbor Commissioners and having met the approval of nearly all the riparian owners it was presented to the Governor and Senate and was approved by them on April 28, 1881.

Application has been made for the establishment of a harbor line on the west side of Pawtucket river above Red Bridge. A line will probably be designed for some two and a half miles of the shore.

OBSTRUCTIONS IN PAWTUCKET RIVER.

The serious artificial obstructions to navigation at India Point, to which we have repeatedly called attention, still exist. The interests of all parts of the State seem to require the interference of the General Assembly to compel the removal of at least the worst of these obstructions and a partial restoration of the free tidal flow and an improvement in the facility for navigation.

LICENSES, ETC.

Licenses have been issued as follows :—

1. April 13, to the Dunnell Manufacturing Company, to rebuild their wharf on the easterly side of Pawtucket river in the town of Pawtucket.
2. May 4, to the Providence, Warren and Bristol Railroad Company to rebuild their bridge at Bowers Cove in the town of East Providence.
3. May 25, to Daniel E. Day to build a seawall on the westerly side of Providence river below Crawford street bridge in Providence.
4. May 28, to the New York, Providence and Boston Railroad Company to build a railroad bridge across the mouth of Brush Neck Cove in Warwick, and also to strengthen the railroad bridge already built across Warwick Cove.

5. July 27, to Mrs. Ellen Wright to extend Wright's wharf on the west side of Pawtucket river, above India Bridge, in Providence.

6. November 15, to the Town Council of the Town of Pawtucket to construct a basin on the east side of Pawtucket river, near the wharf of the Joseph Smith Company, in Pawtucket.

7. November 23, to the Pawtucket Gas Company to fill certain portions of their flats, near their wharf, on the west side of Pawtucket river.

Assent to various constructions has been given as follows :—

1. March 26, to John W. Davis to repair his wharf at Bullock's Point in the town of East Providence.

2. June 8, to the Bay Mill Company—through Albert Hill—to make changes in their wharf in Greenwich Bay, in East Greenwich.

3. August 24, to A. O. Bourn to construct a boat wharf near the foot of Walley street in Bristol.

4. October 19, to W. T. C. Wardwell, to enlarge his wharf at the foot of State street in Bristol.

Action has been taken to prevent unauthorized changes in other places. Constant attention is required in these matters to prevent injurious constructions or encroachments in public tide waters.

DRAW-BRIDGES.

The Commissioners renew their suggestion that further legislation is needed to regulate the times for opening draw-bridges and as to blocking the approaches to draws. Special complaints have been made to the Board in regard to the management of the draw at Stone Bridge — or Howland's Ferry bridge,— between Tiverton and Portsmouth, and also as to the blocking of the passages at India Point, in Providence.

A SUBMERGED ROCK.

In March 1881, a schooner drawing twelve feet of water struck upon a rock hitherto unknown, situated above Half-way Rock and south of Prudence Island. This is now called Fiske Rock and a buoy has been placed upon it bearing N. E. by N. from the spindle on Halfway Rock, and 392 yards distant from it and about three-quarters of a mile from the south end of Prudence Island. The bearings from this buoy are as follows:—North point of Conanicut Island W., N. W., ¼ W., north end of Dyer's Island N. E. by E. ½ E.

WORK OF THE UNITED STATES ENGINEER DEPARTMENT.

By the courtesy of the Chief of Engineers and of General G. K. Warren, the Board has received an advance copy of General Warren's report upon operations in Rhode Island waters, for the year ending June 30, 1881, and a summary, prepared specially for the purpose, giving the operations from June 30 to December 31, on each of the works in the State of Rhode Island. These papers are printed in the appendix herewith.

RAILROAD TERMINAL FACILITIES.

The city of Providence has taken much needed action towards improved railroad facilities and a valuable report may be expected from the able commission charged with the investigation. It is of great importance that railroad tracks, free to the use of all the companies, be run to the entire wharf front of the city and of East Providence, so that the cost of transfer of freight from the vessels to the trains may be reduced to a minimum. It is regarded as quite feasible to do this and at the same time relieve the streets of the city from the great annoyance and danger of running freight cars through its business thoroughfares.

Respectfully submitted,

J. HERBERT SHEDD,
JEDEDIAH WILLIAMS, Harbor Commissioners.
LUCIUS B. DARLING,

Eng 1010.

State of Rhode Island and Providence Plantations.

SIXTH ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1882.

PROVIDENCE:
E. L. FREEMAN & CO., PRINTERS TO THE STATE.
1882.

out of the river, which could not be done at the rate above estimated unless the Washington bridge is rebuilt.

This work is under the superintendence of Assistant Engineer H. A. Bentley.

MONEY STATEMENT.

July 1, 1880, amount available	$529 58
July 1, 1881, amount available	529 58

Improvement of Providence River and Narragansett Bay, Rhode Island.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1881.

The contractors for excavating under the appropriation of $60,000 made March 3, 1879, and the money left over from the abandoned contract under the appropriation of $50,000 made June, 1878 (the first one made for this work), completed their contract January 1, 1881, having removed 558,227.6 cubic yards of material.

By act of Congress approved June 14, 1880, an appropriation of $60,000 was made for the continuance of this work.

Proposals for excavation were invited, publicly, and on the 14th of August, 1880, the following tenders were received :

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	Atlantic Dredging Company, Brooklyn, N. Y	$0 16¾	Oct. 15, 1880..	Sept. 1, 1881.
2	Wm. Flannery, New York	18½	....	
3	Frank Pidgeon, New York....	18½	Within 60 days	Oct. 1, 1881.
4	Jesse and Lyman Boynton, Providence and Boston.	19	....	

The Atlantic Dredging Company were again the lowest bidders, and the contract was awarded to them. They began work March 8, 1881, and at this date, June 30, 1881, they are prosecuting it, having removed 253,100 cubic yards.

The work accomplished during the fiscal year has increased the width of channel 23 feet deep at mean low-water across Pawtuxet Shoal from 70 to 200 feet, and the width of the channel 20 feet deep at mean low-water above Field's Point from 200 to 425 feet.

The adjoining sketch shows the locality and extent of the improvement made.

Congress by act approved March 3, 1881, appropriated $60,000 for continuing this improvement.

Advertisements for proposals for excavation under this appropriation were issued, and on the 8th day of June, 1881, the following tenders were received:

Name and Address.	Price per cubic yard.
Atlantic Dredging Company, Brooklyn, N. Y....	17 cents for depth of 14 feet at mean low-water, and 19 cents for 12 feet depth.

The contract was awarded to the Atlantic Dredging Company, the only bidders.

BULKHEAD ROCK.

Operations for the removal of this rock to a depth of 20 feet at mean low-water were commenced March 8, 1880, and completed October 14, 1880. The contractor's "plant" consisted of a sloop having a carrying capacity of about 80 tons, and a steam hoisting engine, a drilling frame 26 × 32 feet, a steam drilling apparatus, and the ordinary divers, armor, and air-pump. The crew contained seven men, including the captain and divers.

The extreme length of the rock at 20 feet depth was 120 feet, and its general width about 30 feet, so that the drilling frame had to be moved four times to cover the whole surface of the rock. The superficial area was about 2,900 square feet, and the mean depth to be removed 3¾ feet. The total number of holes drilled was 112, and their total penetration 543 feet, an average of about 4.8 feet for each hole. Two hundred and eighty-two pounds of giant powder were used in blasting these holes.

It may be seen from these data that one hole was drilled to each 26.7 feet of superficial area, on which area 2½ pounds of powder were exploded. In addition to this 50 pounds of powder was used in making surface blasts. The large area of rock to each hole drilled and blast made may be accounted for partially by the facts that the rock is of a brittle nature, and the large surface blasts made in 1870 shattered it to a great extent.

There were removed under this contract 794½ tons of rock; which was deposited on the shore east of the work. The explosive material used is known as No. 1, 2, and 3 giant powder.

There is now a depth of 20 feet at mean low-water on this rock; it is even with the surface of the bottom which surrounds it on three sides; on the west or channel side there is a sharp fall of 5 or 6 feet, so that this abrupt face of the rock would confront any vessel of a greater draught than 20 feet, if the vessel should be sailing across the channel. It would not be an obstruction in passing up or down the channel, for the edge of the rock is on the line of channel and does not extend beyond the general contour of 20 feet depth. As the work of improving the main channel progresses and the ultimate depth sought (23 feet at mean low-water) is obtained, it may be found necessary to blast off this edge of the rock, or in some way cover it up so that if a vessel should strike it there would be less danger of serious damage being done.

The improvements in this river have been under the superintendence of Assistant Engineer H. A. Bentley.

The probable operations during fiscal year ending June 30, 1882, will be the continuation of the excavation of a channel 20 feet deep as far as the appropriation of June 14, 1880, will carry it in width. It is proposed with the appropriation of March 3, 1881, to excavate to depths of 12 and 14 feet at mean low-water and as of great a width as the money will pay for.

The depth to be dredged to was changed from 20 to 12 and 14 feet for the reason that the work contracted for would be sufficient to make the 20-foot channel about 500 feet wide, and although this is not as wide by 100 feet as the original plan contemplated, it is a good navigable channel, and it was deemed best to extend the widths of 12 and 14 feet depth and give smaller vessels a chance to anchor and keep out of the deep channel and away from the large craft; leaving the completion of the 20-foot channel to subsequent appropriations.

One hundred thousand dollars could be judiciously expended in the fiscal year ending June 30, 1883, in widening the channel at Pawtuxet Shoal and increasing the anchorage ground above Field's Point.

MONEY STATEMENT.

Improvement of Providence River and Narragansett Bay.

July 1, 1880, amount available	$103,001 28	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$163,001 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	74,330 56	
July 1, 1881, outstanding liabilities	3,258 14	
		77,588 70
July 1, 1881, amount available		85,412 58
Amount (estimated) required for completion of existing project		270,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

Improvement of Providence River—Removal of Bulkhead Rock.

July 1, 1880, amount available	$4,742 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,742 13

IMPROVEMENT OF POTOWOMUT RIVER, RHODE ISLAND.

A report of the survey under which this improvement was planned is printed as part of House Ex. Doc. No. 18, Forty-sixth Congress, third session.

Three estimates were submitted in the above-mentioned report for channels across the bar at the mouth of the river; two providing for a depth of 6 feet at mean low-water, at a cost of $11,550, and one for a depth of 5 feet, to cost $5,587.50.

Congress, by act approved March 3, 1881, appropriated $5,000 for this work, and as this amount is very near the smallest estimate, the project to make the depth of 5 feet was adopted.

Advertisements for excavation were issued, and on June 8, 1881, the following tenders were received:

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	S. A. Hammond, Providence, R. I.	$0 23		
2	John McDermott, Cohoes, N. Y.	40		
3	J. H. Fenner, Jersey City	59	Mar. 15, 1882.	June 30, 1882

The contract was awarded to the lowest bidder, Mr. S. A. Hammond, who is expected to commence the work July 1, 1881.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

MONEY STATEMENT.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year	48 99
July 1, 1881, amount available	4,951 01

SURVEY OF POTOWOMUT RIVER, RHODE ISLAND.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., December 11, 1880.

GENERAL: I forward herewith the report and map of the survey of Potowomut River, Rhode Island, assigned to my charge by you under the law passed at the last session of Congress, and made by Assistant H. A. Bentley.

The survey was asked for for the purpose of making an estimate of the cost of deepening the water to 6 feet at mean low-water over the bar at the mouth, and make the channel 150 feet wide. The present depth is about 2½ feet at mean low water. The dredged channel would be about 2,500 feet long. There are also a few rocks to be removed.

It is estimated that it will cost $11,550 to make a depth of 6 feet at mean low-water, and $5,587.50 to make a depth of 5 feet. The mean rise of the tide is about 4½ feet. Vessels drawing 11½ feet will be able to pass to "Hope Lands" Landing, about ¾ of a mile above the mouth, when the improvement is made.

The navigation to be benefited is that of vessels bringing ashes and other fertilizers and ice, together with small boats and yachts. The region is a rich agricultural one, without manufactories or through travel.

It is in the Providence collection district, and that place is the nearest port of entry.

The amount of revenue collected there for the year ending June 30, 1880, was $405,652.73.

Very respectfully,

G. K. WARREN,
Lieutenant-Colonel Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. H. A. BENTLEY, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., October 28, 1880.

GENERAL: I have the honor to submit the following report on the survey of the Potowomut River, Rhode Island, authorized by Congress at its last session (see section 2 of river and harbor appropriation act approved June 14, 1880).

DESCRIPTION OF THE RIVER AND LOCALITY.

The Potowomut River is an estuary of Narragansett Bay, situated about 13 miles north-northwest of Newport, and extends in from the west shore of Narraganset Bay a distance of about 3 miles, where its name is changed to Hunt's River. Hunt's River is formed by a number of small streams, all within the limits of Rhode Island; its drainage area is about 40 square miles. Coweset Bay, the entrance to the harbor of Greenwich, is situated about half a mile north of the mouth of the Potowomut, with Sandy Point extending out into Narragansett Bay between the two. The point of land between Greenwich Harbor and Coweset Bay and the Potowomut River is known as Potowomut Neck, a beautiful farming country, protected at its east end by a substantial sea-wall built at private expense.

The other or south side of the river is higher ground, rising abruptly at the river to a height of about 30 feet at Bluff Point, where its greatest elevation is obtained.

* * * * * * * * * *

TIDES.

The mean low-water plane to which the soundings are referred, and the mean rise and fall of tide, were determined by simultaneous observations made here and at Providence.

At the time these observations were made the rise of tide was 4.7 feet at Providence, which is the mean rise and fall lately adopted by us there. The rise at Potowomut River at the same time was 4.5 feet, which is taken and used as the mean rise and fall. Low-water at Providence on the same day was 0.5 foot above mean low-water, and at Potowomut it is assumed that the low-tide bears the same relation to mean low-water as it does at Providence. The correctness of this determination is confirmed by the United States Coast Survey tide-tables, which give the mean rise and fall at Greenwich (3 miles away) as 4 5-10. At Wickford, 7 miles nearer the ocean, the mean rise and fall is 4 2-10 feet. At Newport, near the ocean, it is only 3 9-10 feet.

PROPOSED IMPROVEMENT AND ESTIMATES FOR IT.

It was ascertained by consultation with those interested in this work, that a channel with a depth of 6 feet at mean low-water and a width of from 150 to 200 feet across the bar at the mouth of the river, with the removal of Euston's Rocks, was all that was desired or needed.

On the accompanying map two channels, having a width of 150 feet each, have been laid out. The width of 150 feet rather than the one of 200 feet is taken, because it is fully as wide as any part of the channel above, which is large enough for the requirements here. One of the channels is drawn on a straight line connecting the nearest point of the 6-foot contour line outside the bar with the contour having the same depth on the inside. The other proposed channel follows the line of the present channel to the pile of loose stone formerly used as a transfer landing, where it turns and crosses the bar to the nearest portions of the 5 and 6 feet contour lines, outside. If any improvement is to be made here, this latter line is deemed the better, because it is in the line of the greatest tidal flow and would not be so liable to be filled up.

The presence of eel-grass on the inside of the mooring marked on the map indicates that the bottom is not shifting, and that a channel when dredged will not be readily filled up with a new deposit, particularly if it is located in the line of the present tidal flow. Three estimates are submitted. The first is for a channel 150 feet wide and 6 feet deep, on a straight line connecting the deep water on either side of the bar; the second is for the same width and depth of channel, following the present channel to the old landing and thence across the bar; and the third is the same as the second, except that it provides for 5 instead of 6 feet depth.

ESTIMATE FOR CHANNEL 150 FEET WIDE, 6 FEET DEEP AT MEAN LOW-WATER, ON STRAIGHT LINE.

Removal of 50,000 cubic yards mud and sand, at 22½ cents	$11,250
Removal of Euston's Rocks	300
	11,550

ESTIMATE FOR CHANNEL 150 FEET WIDE, 6 FEET DEEP AT MEAN LOW-WATER, FOLLOWING PRESENT CHANNEL TO OLD LANDING.

Removal of 50,000 cubic yards mud and sand, at 22½ cents	$11,250
Removal of Euston's Rocks	300
	11,550

ESTIMATE FOR CHANNEL 150 FEET WIDE, 5 FEET DEEP AT MEAN LOW-WATER, FOLLOWING PRESENT CHANNEL TO OLD LANDING.

Removal of 23,500 cubic yards mud and sand, at 22½ cents	$5,287 50
Removal of Euston's Rocks	300 00
	5,587 50

* * * * * * * * * *

Very respectfully, your obedient servant,

H. A. BENTLEY,
Assistant Engineer.

Bvt. Maj. Gen. G. K. WARREN,
Lieutenant Colonel, Corps of Engineers, U. S. A.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

The House of Representatives, on December 6, 1880, passed a resolution asking "the Secretary of War for information as to the present condition of Newport Harbor, Rhode Island, and what work is necessary to be done to make the harbor available for the purposes of commerce, with an estimate of the cost of the requisite dredging or other work." This was referred to me for report by indorsement from your office, dated December 11, 1880.

December 14, 1880, a report was submitted, with a plan for increasing the capacity of the harbor for anchorage, and as a harbor of refuge. It was proposed to dredge the harbor to a depth of 13 feet where the soft material will allow such depth to be made, and to a lesser depth where hard-pan or rock is encountered before reaching 13 feet. This work to be done east of the main channel, through the harbor between the city of Newport and Goat Island, and between Long Wharf and Lime Rock. The estimated amount of material to be removed is 327,000 cubic yards of mud and sand and a few bowlders; to cost $72,000.

At some future time, for the further increase of anchorage facilities, it may be desirable to deepen the cove east of Fort Adams and remove a portion of the shoal south of Goat Island.

Congress, by act approved March 3, 1881, appropriated $25,000 for this work.

Advertisements for proposals for excavation were issued, and on the 8th of June, 1881, the following tenders were received:

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	Henry E. Du Bois, New York City	$0 11		June 30, 1882
2	H. N. and A. J. Beardsley, Bridgeport, Conn	11½		June 30, 1882
3	S. A. Hammond, Providence, R. I	12		June 30, 1882
4	Atlantic Dredging Company, Brooklyn, N. Y	12		June 30, 1882
5	William Flannery, New York City	15		June 30, 1882
6	John McDermott, Cohoes, N. Y	17		June 30, 1882
7	J. H. Fenner, Jersey City, N. J	20	Sept. 1, 1881.	June 30, 1882
8	Elijah Brainard, jr., New York City	25	Sept. 1, 1881.	June 30, 1882

The contract was awarded to the lowest bidder, Mr. Henry E. Du Bois.

The probable operations during the fiscal year ending June 30, 1882, will be dredging for increased anchorage-ground, to a depth of 13 feet at mean low-water, as far as the available money will allow.

It is probable that $47,000, the remainder of the estimate for this new project, can be profitably expended in the fiscal year ending June 30, 1882.

This improvement has been under the Supervision of Assistant Engineer J. P. Cotton.

MONEY STATEMENT.

Amount appropriated by act approved March 3, 1881	$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	167 15
July 1, 1881, amount available	24,832 85
Amount (estimated) required for completion of existing project	47,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	47,000 00

IMPROVEMENT OF BLOCK ISLAND HARBOR, RHODE ISLAND.

An estimate for increasing the depth at the entrance to and in this basin was called for by a resolution of the House of Representatives in February, 1880. A report with estimate was submitted March 15, 1880, which provided for increasing the depth of the inner harbor and its entrance from 7 to 9 feet at mean low-water, and for the removal of a wreck.

WORK DONE DURING FISCAL YEAR ENDING JUNE 30, 1881.

Congress, by act approved June 14, 1880, appropriated $6,000 for this work.

Advertisement for proposals for dredging was issued July 24, 1880, and on the 14th of August the following proposals were received:

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	McDermott & Daly, Cohoes, N. Y	$0 28	Oct. 1, 1880	Dec. 1, 1880
2	Elijah Brainard, jr., New York City	32	Sept. 20, 1880	Dec. 1, 1880
3	William Flannery, New York City	37	....	Dec. 1, 1880

The contract was awarded to the lowest bidders, Messrs. McDermott & Daly, who commenced the work in October and completed it in December, 1880. Sixteen thousand one hundred and forty-six cubic yards of material were removed, making a depth of 9 feet at mean low-water at the entrance to and in the inner harbor or basin.

The wreck lying near the Fall River Iron Company's wharf was removed.

Two bowlders, on one of which there was a depth of but 6¼ feet at mean low-water, were removed from the outer harbor. These bowlders weighed about 28 tons. The removal of the wreck and bowlders was done by hired labor.

The estimated cost of this improvement was $8,000, but the favorable price at which the dredging was done enabled us to do all that was required with the $6,000, the amount of the appropriation.

There is no immediate demand for an extension of the breakwater, but there undoubtedly will be before long, for the general purposes of coast and ocean navigation.

The present work is designed to furnish the initial point for the work of the future, so that it can be most economically and rapidly constructed when required.

This work has been under the superintendence of Assistant Engineer J. P. Cotton.

MONEY STATEMENT.

July 1, 1880, amount available	$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,873 74
July 1, 1881, amount available	126 26

IMPROVEMENT OF LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

Up to the end of the fiscal year, June 30, 1880, there had been expended, in cutting a channel giving 7½ feet deep through the shoals, $19,798.58.

This expenditure was mainly confined to the eastern part, near Pawcatuck Point, where the material was very hard. The channel was made 185 feet wide through this, and for a least width of 40 feet through the other part, which left it still too narrow to be much used by navigators.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1881,

On the 14th of August the following tenders for excavating, under the appropriation of June 14, 1880, were received.

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	W. H. Beard, Brooklyn, N. Y.	$0 18	Mar. 15, 1881	June 30, 1881
2	McDermott & Daly, Cohoes, N. Y.	22	....	June 30, 1881
3	William Flannery, New York City	30	....	June 30, 1881

The contract was awarded to the lowest bidder, who, in April, 1881, applied for an extension of his time of beginning and completion from March 15, 1881, to May 15, 1881, and from June 30, 1881, to July 15, 1881, respectively. This extension was granted.

On the 23d of May the work was commenced, and at the end of the fiscal year the contractor is still engaged on it, having removed 8,092¼ cubic yards of material and increased the width of the new channel from 40 feet to 60 feet.

The amount of money expended during fiscal year ending June 30, 1881, is $490.13.

Congress, by act approved March 3, 1881, made an appropriation of $5,000 for continuing this work. Advertisements for proposals for excavation under this appropriation were issued, and on the 8th day of June, 1881, the following tenders were received.

No.	Name and Address.	Price per cubic yard.	Commence.	Complete.
1	J. H. Fenner, Jersey City, N. J.	$0 20	Aug. 1, 1881.	Oct. 15, 1881
2	John McDermott, Cohoes, N. Y.	22⅛	....	....

The contract was awarded to Mr. J. H. Fenner, the lowest bidder.

THE PROBABLE OPERATIONS DURING THE YEAR ENDING JUNE 30, 1882.

The channel, 7½ feet deep at mean low-water, will be widened as far as the available money will pay for. It is expected that the work provided for will make a width of about 140 feet, which will give, with good ranges, a safely navigable channel, and will enable steamboats and vessels bound for Watch Hill, and the Pawcatuck River, and Westerly, to cross the bay at any stage of the tide. If going up the river, they can then take the full advantage of the tide and the improvements previously made under the general government in the Pawcatuck River.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

The amount of money estimated as being necessary to complete the improvement in accordance with the project approved and adopted is $21,000, and this amount could be judiciously expended in the fiscal year ending June 30, 1883.

MONEY STATEMENT.

July 1, 1880, amount available	$5,201 42	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,201 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities, July 1, 1880		490 13
July 1, 1881, amount available		9,711 29
Amount (estimated) required for completion of existing project		21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		21,000 00

ENGINEER OFFICE U. S. ARMY,
Newport, R. I., January 21, 1882.

Bvt. Maj.-Genl. H. G. Wright, U. S. A., Brig.-Genl. and Chief of Engineers, Washington, D. C.:

GENERAL: I have the honor to transmit herewith a résumé of operations from June 30 to December 31, 1881, on each of the works in the State of Rhode Island, as directed by first indorsement on Communication from J. Herbert Shedd to you. They are as follows:

Providence River, R. I.
Potowomut River, R. I.
Newport Harbor, R. I.
Little Narragansett Bay, R. I. and Conn.

Mr. Shedd's letter is also inclosed.

Very respectfully,

G. K. WARREN,
Lieut.-Col. Engrs. and Bvt. Maj.-Genl. U. S. A.

PROVIDENCE RIVER, R. I.

Since June 30, 1881, the date of the annual report, the work of dredging has been continued in widening and deepening the channel above Field's Point. The amount of material removed was 168,214 cubic yards.

The funds available will enable the work to be continued until the end of the fiscal year, June 30, 1882.

POTOWOMUT RIVER, R. I.

This improvement has been completed since the date of the annual report.

A channel 115 feet wide and 5 feet deep at mean low-water has been dredged across the bar at the entrance of the river, and the width of the channel increased above by dredging off points of shoals. The amount of material removed was 15,012 cubic yards of sand and 63 cubic yards of rocks. The rocks removed were known as Easton's Rocks.

NEWPORT HABROR, R. I.

Since the date of the annual report work has been commenced on the improvement of this harbor. There have been dredged in the upper part of the harbor 91,100 cubic yards of material.

The depth sought is 13 feet at mean low-water, in order to increase the anchorage capacity. It is expected that the available funds will be expended by the end of the fiscal year, June 30, 1882.

LITTLE NARRAGANSETT BAY, R. I. AND CONN.

Since the date of the annual report there have been removed 33,683 cubic yards in increasing the width of the channel across the bay to 140 feet in width and 7½ feet deep at mean low-water.

A small amount of the appropriation is reserved to remove rocks next Spring. The channel is now available, and is used by vessels going up the Pawcatuck River.

Eng 1010.37

State of Rhode Island and Providence Plantations

SEVENTH ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, 1883.

PROVIDENCE:
E. L. FREEMAN & CO., STATE PRINTERS.
1883.

State of Rhode Island and Providence Plantations.

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1883.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.

The Board of Harbor Commissioners respectfully submit their Seventh Annual Report:

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, reappointed J. Herbert Shedd, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

WORK WITH U. S. GOVERNMENT APPROPRIATION.

By act of Congress of August 2, 1882, the Secretary of War was directed at his discretion to cause a survey of the Pawtucket river and estimates of the cost of the improvement proper to be made. The U. S. Engineer Department has long been opposed, apparently, to the expenditure of public funds for the improvement of this river while the present bridge obstructions remain at its outlet. In his report of the year 1874, General Warren made the following statement. "I deem it, therefore, a matter of importance that some steps should be taken—what ones, exactly, I do not know—to control the bridging of the Pawtucket river in the interest of navigation; and unless such control is acquired by the general government, it seems to me out of place to further regard the improvement of the Pawtucket river as a public one, or that that estuary is longer a navigable water of the United States." It might naturally be assumed by the government that if the navigation of the river is worth preserving the State of Rhode Island would interfere for the removal of the obstructions and the simplest plan for the United States would be to withhold appropriations until this is done. Whatever has been the cause the fact is that no appropriations have been made for this river since 1873. The survey and estimates authorized August 2, 1882, have not yet been ordered. The number of vessels passing through the Washington Bridge at India Point, according to the City Engineer of the city of Providence, was two thousand six hundred and seventy-five during the year 1882. The navigation would undoubtedly be much larger than this if the obstructions were removed.

The improvement of Providence river and Narragansett Bay under the appropriation of 1881, was prosecuted up to April 26, 1882, when the available funds were exhausted. The total number of yards removed under contract dated July 8, 1881, was 322,255.2.

By resolution of the Senate of the United States the Secretary of War was directed to transmit to the Senate estimates of the cost of increasing the depth of the main ship-channel of Providence river and harbor to 25 feet, with 300 feet in width, at mean low water. General Warren estimated the cost over and above that of making a channel with a depth in the centre of 23 feet, gradually shoaling to a depth of 6 feet as provided for in the adopted project of 1878, at $175,000. Congress appropriated $125,000 August 2, 1882, presumably in furtherance of the amended project, which was estimated at $445,000 including the uncompleted project of 1878. A contract has been made for dredging a channel 25 feet deep at mean low water, at 16 cents per cubic yard. Up to January 1 about 200,000 cubic yards had been removed under this contract. It is expected that the funds available will secure a channel 200 feet wide and 25 feet deep from Fox Point to the sea, and that it will be completed by December 1, 1883.

The report of Gen. G. K. Warren, Lieutenant-Colonel of Engineers in charge of the improvement of harbors and rivers on this section of the coast, to the Chief of Engineers, U. S. A., is largely quoted in the appendix to this report.

The Commissioners feel that the State, as well as the nation, has suffered great loss in the death of General Warren, so long in charge of government work here, who was a member of the Advisory Council appointed by the President of the United States to aid this Board.

By courtesy of George H. Elliot, Lieutenant-Colonel of Engineers, successor to General Warren, the Board has been furnished with a full statement of the progress in his department since June 30, 1882, which may be found in the appendix.

DUMPING GROUNDS.

The general dumping ground continues to be in deep water near Half-Way Rock, east of Conanicut Island. Assent has been given to the Bridge Mill Paper Company of Pawtucket, to dump, under restrictions, upon the flats above Hemlock Point. Unauthorized dumping on the flats below the Wilkesbarre Pier in Providence Harbor, was stopped by action of the Board. Assent has been given to Samuel A. Hammond to dump a limited amount, under restrictions, on the flats above Harbor Junction Pier on the west side of Providence Harbor.

HARBOR LINES.

A petition was received by the Board praying for the establishment of a harbor line on the west side of Narragansett Bay near to and including Wickford Harbor. This being in Washington county, the Commissioners took no action in the matter.

Upon petition of nearly all the riparian owners between Bensley's Point on the west side of Pawtucket river, and the Red Bridge, a harbor line was designed along that shore and the plans and descriptions thereof will be submitted for approval as required by law.

Applications have been made for changes in harbor lines in two locations. No steps towards such changes have been taken by the Board. It is believed that harbor lines once established should be permanent except where grave reasons arise calling for a change.

The harbor line on the west side of Providence river from Point Street Bridge to opposite Henderson street is under consideration by the Board. Every wharf owner along this shore encroaches beyond the ancient line, though the structures were probably placed within the line when built.

LICENSES, ETC.

Licenses have been issued as follows:

1. February 18. To Smith Grant & Company, to construct a wall and make improvements on their wharf property on the westerly side of Pawtucket river in the town of Pawtucket.

2. April 5. To the Pawtucket Gas Company to build a wall and wharf on their estate on the westerly side of Pawtucket river in the town of Pawtucket.

3. May 8. To Henry C. Clark, to make alterations in the Dorrance street wharf, so called, in the city of Providence.

4. May 18. To the Pawtucket Coal Company, to build a bridge wharf on the Joseph Wood's Heirs estate on the easterly side of Pawtucket river in the town of Pawtucket.

5. June 28. To Allen Greene, to erect a small building opposite his estate, on the westerly side of Providence river, near Pawtuxet Neck, in the town of Cranston.

6. September 27. To the Providence Gas Company to drive piles and make repairs at their South Station on the westerly side of Providence Harbor in the city of Providence.

7. November 29. To the East Providence Land Company, to place dolphins opposite their estate and near the Marine Railway in East Providence.

8. December 13. To Thomas J. Hill, to repair his wharf on the westerly side of Providence Harbor opposite Henderson street in the city of Providence.

DRAW-BRIDGES.

The Commissioners renew their suggestion that further legislation is needed to regulate the times for opening draw-bridges and as to blocking the approaches to draws.

LIGHT HOUSES.

During the year 1882, the United States Government has erected a new Light House on Whale Rock. A tower in the form of the frustum of a cone, standing on a pier. The tower is white, the pier red, and the lantern black. A fixed red light, forty-three feet from the ground, is established, visible fourteen miles. The fog signal is a bell struck by machinery giving one blow at intervals of twenty seconds.

A new Light House has also been constructed on Old Gay Rock in Wickford harbor. A square tower is attached to a dwelling standing on a pier. The tower is white, the pier red, and the lantern black. A fixed white light, forty-two feet from the ground, is established, visible twelve miles. During thick and foggy weather a bell struck by machinery will be sounded, giving one blow at intervals of twenty seconds. The old light house on Poplar Point is not now lighted. It is S. W. by W. one-seventh of a mile from the new station.

A new tower has been erected for the Conimicut Light. It is a round white tower, fifty-feet high, standing upon a red pier, with a black lantern. The fog-signal is a bell struck by machinery, one blow every fifteen seconds. The light-ship which had been moored near there was removed on the thirteenth of December and the light in the tower was reëstablished.

APPENDIX.

Valuable information relating to the interests intrusted to this Commission will be found in the appendix to this report.

Respectfully submitted,

J. HERBERT SHEDD, JEDEDIAH WILLIAMS, LUCIUS B. DARLING,	Harbor Commissioners.

APPENDIX.

ABSTRACT FROM REPORT OF GENERAL G. K. WARREN TO CHIEF OF ENGINEERS, U. S. A., FOR 1882.

Improvement of Pawtucket (Seekonk) River, Rhode Island.

The project, so far as adopted and improved, is completed. There is an unexpended balance of $529.58 which still remains for contingencies. No expenditure in the fiscal year ending June 30, 1882.

The mouth of this river is obstructed by two bridges, with badly arranged draws. Several efforts to remove these obstructions have been made by the local and State authorities, but as yet with no definite result.

No appropriations for this improvement have been made since 1873. No appropriation is asked for fiscal year ending June 30, 1884.

MONEY STATEMENT.

July 1, 1881, amount available	$529 58
July 1, 1882, amount available	529 58

Improvement of Providence River and Narragansett Bay, Rhode Island.

At the date of the last annual report the Atlantic Dredging Company were at work dredging under contract dated August 25, 1880. Work on this contract was commenced in March, and it was completed July 30, 1881; 322,140 cubic yards of material were removed.

This dredging increased the width of the 20-foot channel previously made between Harbor Junction Pier and Field's Point from 300 to 450 feet, except at the Point of Long Bed, where hard material that could not be dug by a clam-shell machine was found at a depth of 16 feet at mean low water. An additional cut was also made on the west side of the 20-foot channel, between Harbor Junction Pier and Hill's Wharf.

At the time of the completion of this contract there was a least width in the 20-foot channel of 450 feet, except at the Point of Long Bed, where it was but 400 feet wide.

Congress, by act approved March 3, 1881, appropriated $60,000 for continuing this improvement. It was decided to expend this money in increasing the width of channels 12 feet deep at mean low water, so as to afford better anchorage for the smaller class of vessels, and thus keep the main channel free. When tenders were asked, however, only one company bid, and they made the offer to dredge to 12 feet depth for 19 cents per yard, and to make a depth of 14 feet for 17 cents per yard. The adopted project called for a width of 940 feet of 12 feet depth, and a width of 725 feet of 18 feet depth. It was clearly in the interest of the economical prosecution of the work to accept both prices and make a depth of 14 feet over that part that the project called for 18 feet, and then expend what money remained in making 12 feet.

Work on this contract was commenced August 1, 1881, and prosecuted up to April 26, 1882, when the available funds were exhausted. A depth of 14 feet was made on the west side of the channel, below Hill's Wharf, for a width of 100 feet. The lower end of Green Jacket Shoal was taken off for a width of 250 feet to a depth of 14 feet, and the east side of the channel below Wilkesbarre Pier was widened 200 feet, with a depth of 14 feet. The 12-foot depth made was confined to the west side of the channel below Hill's Wharf, where, commencing on the west side of the 14-foot cuts, it was extended 120 feet farther west, running down river about two-thirds of the distance to Harbor Junction Pier.

The total number of yards removed under contract dated July 8, 1881, was 322,255.2.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

Under date of March 17, 1882, the following resolution was passed in Senate of the United States:

> *Resolved by the Senate of the United States*, That the Secretary of War is hereby directed to transmit to the Senate estimates of the cost of increasing the depth of the main ship-channel of Providence River and harbor to 25 feet, with 300 feet in width at mean low water; also to report what portion of the estimated cost of said improvement can be expended to advantage during the next fiscal year.

In obedience to this resolution, a report was submitted by me March 24, which was transmitted to Congress and printed as Senate Ex. Doc. No. 145, Forty-Seventh Congress, first session. It is appended to this report.

The cost of making a channel 300 feet wide and 25 feet deep at mean low water over and above that of making a channel with a depth in the centre of 23 feet, gradually shoaling to a depth of 6 feet as provided for in the adopted project of 1878, was estimated at....	$175,000
To complete project of 1878 still required..	270,000
Total cost of entire improvement..	$445,000

The appropriation of $125,000 made by act of Congress August 2, 1882, will be expended during the fiscal year June 30, 1883, in making the channel 25 feet deep at mean low water to as great an extent as the money will pay for.

MONEY STATEMENT.

July 1, 1881, amount available	$85,412 58
July 1, 1882, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881	81,948 09
July 1, 1882, amount available	$3,464 49
Amount appropriated by act passed August 2, 1882	125,000 00
Amount available for fiscal year ending June 30, 1883	$128,464 49
Amount (estimated) required for completion of existing project	$320,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1884	200,000 00

SPECIAL REPORT ON IMPROVEMENT OF PROVIDENCE RIVER AND HARBOR, RHODE ISLAND.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., March 24, 1882.

GENERAL: I have the honor to submit the following report, as directed by you under date of March 22, 1882, upon the cost of making a channel 300 feet wide and 25 feet deep at mean low water, from deep-water in Narragansett Bay to Fox Point, Providence, R. I.

(1.) The project upon which we have been working is to make a channel 23 feet deep at mean low-water and a width of 200 feet from Field's Point to the ocean. This has been completed with the exception of the removal of about 25,000 cubic yards at Gaspee Shoal, where there is a least depth of 21 feet at mean low-water.

(2.) The space between Field's Point and Fox Point the plan contemplates making a harbor of, of the following proportions:

Of a least depth of 23 feet, 150 feet wide.
Of a least depth of 20 feet, 600 feet wide.
Of a least depth of 18 feet, 725 feet wide.
Of a least depth of 12 feet, 940 feet wide.
Of a least depth of 6 feet, 1,060 feet wide.

Of this second part the channel of 20 feet depth has been completed to a least width of 450 feet, in some places 500 feet; and from 12 to 14 feet depth has been made in a portion of it for a width of 840 feet.

There has been appropriated, and nearly expended, $230,000, leaving $270,000 of the estimate for completing the foregoing plan.

To now enlarge the project so as to secure a mean low-water depth of 25 feet and width of 300 feet from Fox Point wharf to the ocean will require the dredging of the following additional amounts, not before included:

	Cubic yards.
Between Fox Point and Field's Point	265,000
Between Field's Point and Pawtuxet Shoal	125,000
At Pawtuxet Shoal, about 2 miles below Field's Point	235,000
At Gaspee Shoal, about 1 mile below Pawtuxet Shoal	165,000
	790,000

This work of deep dredging and towing to distant dumping ground will cost probably 20 cents per cubic yard:

790,000 cubic yards, at 20 cents	$158,000
For superintendence, &c	17,000
Additional cost of enlarged channel	$175,000

The entire amount to be appropriated to complete the improvement of Providence Harbor and River is then as follows:

Amount required on first project	$270,000
Additional amount required on enlarged project	175,000
	$445,000

This work can be prosecuted at all points at once, and at least $200,000 could be expended in a favorable year, if proper contractors can be secured for the operations.

Accompanying this report are the following maps:

(No. 1.) Coast Survey map of Narragansett Bay, with the curve of 25 feet depth and the proposed dredging shown in red.

(No. 2.) A map of Providence River from Fox Point to Field's Point, showing the present depths, with the proposed dredging shown in red. This is a tracing on a scale of 200 feet to the inch.

(No. 3.) A map of Providence River from Field's Point down to and including Gaspee Shoal, with the proposed channel shown in red. This is a tracing on a scale of 400 feet to an inch.

Very respectfully,

G. K. WARREN,
Lieutenant Colonel of Engineers,
Bvt. Maj. Gen. U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A. Washington, D. C.

STATE OF RHODE ISLAND, ETC.,
OFFICE OF THE HARBOR COMMISSIONERS,
2 MARKET SQUARE, CORNER OF CANAL STREET,
Providence, R. I., March 20, 1882.

Hons. HENRY B. ANTHONY,
NELSON W. ALDRICH,
JONATHAN CHACE,
HENRY J. SPOONER,
Senators and Representatives:

GENTLEMEN: I am directed by the harbor commissioners to commend to you the communication of the president of the board of trade, urging an appropriation by Congress for increasing the width and depth of water-way across the bars in the channel leading to Providence Harbor.

In the opinion of this board the city of Providence has peculiar advantages of location as an importing and exporting station. Its outer harbor is Narragansett

Bay, containing about 70 square miles of anchorage area, completely land-locked, where all the shipping of the country could ride out any storm in safety. Two unobstructed passages lead to this basin, and through one or the other the largest vessels that float could enter without a pilot in a storm from any quarter. Ice never prevents making a good harbor here. For about 20 miles from the sea vessels of 30-feet draft could find free passage, but from that point to the city a few bars occur which will prevent their further passage until a deeper channel is dredged across them.

There is, perhaps, no harbor in the country where dredging can be done at less cost per yard, and there is little silt naturally brought down by the rivers. The channel once deepened would be permanent, or could be maintained at very small average annual expenditure.

As no strong natural forces tend to shoal the entrance from the sea, as at some of our ports, and no ledge needs to be removed, at great expense, to gain sufficient depth, as at others, the harbor of Providence offers, in our belief, great inducements for improvement to secure some of the increased accommodations required by the growing traffic of the country with foreign nations.

Very respectfully,

J. HERBERT SHEDD,
Chairman.

STATE OF RHODE ISLAND, ETC.,
IN GENERAL ASSEMBLY,
January Session, A. D. 1882.

RESOLUTIONS relative to the harbor of the city of Providence.

Whereas within the past few weeks a direct railroad communication has been established between the city of Providence and the Western States, by which the varied products of that great section of country, that are transported over the main trunk lines of railroad, may be distributed not only throughout New England, but also forwarded to foreign lands by the unequalled facilities of Narragansett Bay; and

Whereas this new communication has been secured by the completion of the New York and New England Railroad, the managers of which have declared their willingness and their determination to afford to the city of Providence equal advantages with the city of Boston in the transportation and delivery of freight at tide-water in said city of Providence; and

Whereas the city of Providence has declared its intention to improve its tide-water facilities by the vote of its city council to expend the sum of $75,000 during the present season in dredging that portion of the harbor within its jurisdiction; and

Whereas the board of trade in said city has by its action and through its officers and committees secured assurances from responsible parties that the large ocean steamers for foreign trade can and will be sent to said city as soon as the dredging now required shall be accomplished; and

Whereas it is desirable and necessary that, in view of these facts, the sum to be expended by the general government during the approaching season should be largely augmented to the end that the present ship channel may be deepened to a depth of not less than 25 feet at mean low-water, and widened to a width of not less than 300 feet: Therefore,

Resolved (*the House of Representatives concurring herein*), That the Senators and Representatives from this State in Congress be requested to take such action as shall to them seem most expedient to obtain such an increase in the annual appropriation for immediate use in the harbor of Providence and the approaches thereto as will secure the deepening and widening of the main ship channel, as above set forth.

Resolved, That a duly authenticated copy of the aforegoing be forwarded to each of the Senators and Representatives from this State in the Congress.

I certify the foregoing to be a true copy of resolutions passed by the general assembly of said State March 21, 1882.

JOSHUA M. ADDEMAN,
Secretary of State.

IMPROVEMENT OF POTOWOMUT RIVER, RHODE ISLAND.

Congress, by act approved March 3, 1881, appropriated $5,000 for this improvement. Proposals for dredging under this appropriation were publicly invited, and the work awarded to Mr. S. A. Hammond, the lowest bidder, at 23 cents per cubic yard. (See last annual report.)

Mr. Hammond commenced work on his contract July 1, 1881, and continued until its completion, in October, 1881; 15,012 cubic yards of sand and mud were removed. The greater part of this work was done in making a channel 115 feet wide and 5 feet deep at mean low-water across the bar at the mouth of the river. The other dredging done was at sharp points in the river between the mouth and Hopeland's wharf. These points were cut off, so as to make the channel easier to navigate. An old landing, composed of 93 yards of stone and 12 logs, was was also removed by the contractor.

Euston's Rocks were removed to a depth of 5 feet at mean low-water by divers employed by the day; 63 tons of rock were removed in all, at an expense of $496.

This improvement was under the superintendence of Assistant Engineer H. A. Bentley.

The project, with the modification of width of channel from 150 feet to 115 feet, is completed, and no further appropriation is asked.

MONEY STATEMENT.

July 1, 1881, amount available	$4,951 01
July 1, 1882, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881	4,951 01

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

At the date of the last annual report a contract had been made with Mr. Henry E. Dubois for dredging under the appropriation of $25,000 by act approved March 3, 1881.

The work of excavation was commenced July 19, 1881, and prosecuted up to

December 17, 1881, when 91,102[illegible] cubic yards, or about one-half the contract, had been completed.

In drawing specifications for this work it was assumed that the material forming the bottom was mud, like that of the surface, and that a sufficient quantity at least would be found, the removal of which would exhaust this appropriation. As the work of dredging was continued it was ascertained that in many places this covering of mud was only about 1 foot thick, and underlying this was a formation of stiff clay, with occasional ridges of sand, gravel, and small bowlders. In the early part of the work these ridges were only occasionally found, but they increased in size and number as the work went on. The contract called for the removal of mud only, and when these hard spots were met they were left.

It was thought that the interests of the improvement suffered under this method of proceeding, and that it would cost more to go over the work twice, as it would be necessary to do to leave the required depth of 13 feet; at the same time it was entailing a hardship on the contractor to compel him to work at such disadvantage. The contract was therefore annulled by mutual consent.

Proposals to dredge to 13 feet depth at mean low-water, and calling for the removal of mud, shells, gravel and small stones, clay and sand, and bowlders when not too large to go in dipper of dredge, were advertised for under date of January 20, 1882.

The following proposals were received and opened February 6, 1882:

No.	Name of Bidder.	Price per cub. yd.	Commence.	Complete.
1	Edgar M. Payn, Albany, N. Y.	$0 19.9	March 1, 1882.	Aug. 31, 1882.
2	Hartford Dredging Company, E. H. Williams president, Hartford, Conn.	20	April 1, 1882.	Aug. 31, 1882.
3	John H. Fenner, No. 227 Pine St., Jersey City, N. J.	29⅞	April 1, 1882.	Aug. 31, 1882.
4	John Van Patten, Rahway, N. J.	31	Within 10 days.	Aug. 31, 1882.
5	John McDermott, Cohoes, N. Y.	31	April 1, 1882.	Aug. 31, 1882.

The contract was awarded to Mr. E. M. Payn, the lowest bidder. Mr. Payn commenced work March 25, 1882, and at this date is prosecuting it. The total number of cubic yards removed during fiscal year ending June 30, 1882, is 115,697[illegible]. The anchorage area between Commercial Wharf and Long Wharf of from 11 to 13 feet depth at mean low-water has been increased about 16 acres.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

The original estimate for increased anchorage was made without a special survey, and the material was thought to be mud, and that it could be dredged with clam-shell dredges. This proved to be otherwise, and the difficulty of digging made the cost 50 per cent. more than was estimated. Hence the original estimate should, on account of the hardness of the material, and also on account of enhanced prices of labor and material, be increased from $72,000 to $108,000. Add to this probably 80,000 cubic yards at 30 cents per cubic yard (not included in above) to deepen, straighten, and widen the entrance on the south side of Goat Island to 13 feet at mean low-water (this is much desired by the steamboat navigation), we thus have a

Total cost of	$132,000
There has been appropriated	45,000
Leaving to be provided	$87,000

There could be profitably expended in one year $50,000.

MONEY STATEMENT.

July 1, 1881, amount available		$24,832 85
July 1, 1882, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881	$16,302 35	
July 1, 1882, outstanding liabilities	489 45	
		16,791 80
July 1, 1882, amount available		$8,041 05
Amount appropriated by act passed August 2, 1882		20,000 00
Amount available for fiscal year ending June 30, 1883		$28,041 05
Amount (estimated) required for completion of existing project		$87,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1884		50,000 00

IMPROVEMENT OF BLOCK ISLAND HARBOR, RHODE ISLAND.

No work has been done here during the past year. The small amount of money on hand is insufficient to do anything more than make an examination, if one were needed.

In obedience to a resolution of the Senate, a report on the condition of the government wharf and docks and estimate of repairs and protection were submitted. This report was printed as Senate Ex. Doc. No. 26, Forty-seventh Congress, first session; it is appended to this report.

The appropriation of $19,000 by act of Congress of August 2, 1882, will be expended during the fiscal year ending June 30, 1883, in making the repairs and cliff protection estimated for in the appended report.

An appropriation of $35,000 could be judiciously expended in the fiscal year ending June 30, 1884, in extending the main work to secure additional shelter, and in this way relieve the basin, which is at times too small to meet the demands upon it.

MONEY STATEMENT.

July 1, 1881, amount available	$126 26
July 1, 1882, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881	61 12
July 1, 1882, amount available	$65 14
Amount appropriated by act passed August 2, 1882	19,000 00
Amount available for fiscal year ending June 30, 1883	$19,065 14
Amount (estimated) required for completion of existing project	$35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1884	35,000 00

GOVERNMENT WHARF AT BLOCK ISLAND, RHODE ISLAND.

ENGINEER OFFICE, UNITED STATES ARMY.
Newport, R. I. December 7, 1881.

GENERAL: In accordance with the indorsement on the communication from the Hon. Nelson W. Aldrich, in relation to the wharf at Block Island, I submit the following:

The government wharf referred to is the platform of spruce on the inside of the basin at Block Island. This is laid on spruce beams, one end of which rests on spruce-timber cribs, the other upon oak piles. This, as well as the basin itself, was but a temporary structure, to aid in carrying on the main work and get immediate shelter. The whole is about rotted out.

During this season I had prepared an estimate for replacing the eastern side of the basin (which forms part of the main work) with masonry. It is important to have this done at once; it will require an outlay of $10,000. There is also a requirement that the cliffs to the east should be protected from further abrasion by the waves, to prevent the material washing into the area protected by the breakwater. For this I have estimated that 850 feet of cliff requires protection, at a probable expense of $8,500. When replacing the eastern side of the basin we can arrange to do away with the rotten spruce platform as it now is. But if anything is done to the rest of it, I would recommend patching it. The oak piles appear still good to last for some time. The patching can be done for $500. To replace the whole of the wharf or platform inside the basin will cost at least $5,000, if made of hard wood. But it wonld not be well to do it unless the north and west sides of the basin are rebuilt, and this would cost of itself $15,000. Better than this it would be to extend and increase the main breakwater so as to gain shelter in that way. An expenditure of $35,000 more on the main work will enable the whole protected space to be used as the basin now is.

To recapitulate, I would recommend an appropriation at once—

For replacing the east side of the basin	$10,000
For protection to cliffs for saving the area sheltered by the breakwater	8,500
For patching the government wharf	500
	$19,000

Very respectfully,

G. K. WARREN,
Lieutenant-Colonel of Engineers.

Bvt. Maj. Gen. H. G. WRIGHT,
Brig. Gen. and Chief of Engineers, U. S. A.

IMPROVEMENT OF LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

At the date of June 30, 1881, the work of excavation under appropriation by act approved June 14, 1880, was in progress under the contract of Mr. W. H. Beard, dated August 28, 1880. Work under this contract had been commenced in May, 1881; it was completed August 31, 1881.

On the completion of this contract the same dredging machines continued work on the contract of Mr. J. H. Fenner, dated June 30, 1881, under the appropriation of $5,000 by act approved March 3, 1881. This work was completed in October, 1881.

The total amount of material removed under contract during the fiscal year was 33,683 cubic yards. The removal of this amount of material increased the width of channel, 7½ feet deep, from 60 to 140 feet.

At the close of dredging operations in 1881 about $1,000 remained on hand. This money was retained for the purpose of removing rocks at the east entrance of the new channel and at the entrance to Watch Hill Landing.

In April, 1882, a schooner, with crew, divers, &c., was hired by the day to remove these rocks. This work was carried as far as the limited amount of money would permit. Twenty-five rocks, with less than 7 feet depth on them at mean low-water, were removed from the east entrance of new channel. This number was all that could be found. At Watch Hill fifty-seven bowlders were removed. There are still a few large and some small rocks there that should be removed. The work done, however, has materially helped the navigation.

This work is under the superintendence of Assistant Engineer H. A. Bentley.

The appropriation of $6,000 made by act of Congress passed August 2, 1882, will be applied to continuing this improvement in accordance with plans heretofore submitted and approved.

Fifteen thousand dollars could be expended during the fiscal year ending June 30, 1884, in completing the projected improvement of this bay.

MONEY STATEMENT.

July 1, 1881, amount available	$9,711 29
July 1, 1882, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881	9,433 41
July 1, 1882, amount available	$277 88
Amount appropriated by act passed August 2, 1882	6,000 00
Amount available for fiscal year ending June 30, 1883	$6,277 88
Amount (estimated) required for completion of existing project	$15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1884	15,000 00

SUMMARY OF PROGRESS OF WORK UNDER THE UNITED STATES ENGINEERS TO JANUARY 1, 1883, FURNISHED BY LIEUTENANT-COLONEL GEORGE H. ELLIOT, IN CHARGE.

ENGINEER OFFICE, UNITED STATES ARMY.
Newport, R. I. January 18, 1883,

MR. J. HERBERT SHEDD, C. E.,
Chairman Harbor Commission, Providence, R. I.

DEAR SIR: In reply to yours of January 3d I forward herewith, by authority of the Chief of Engineers, a brief statement of work done on improvements of rivers and harbors in this State since June 30, 1882.

Very respectfully,

GEORGE H. ELLIOT,
Lieut.-Col. Engineers.

Seven (7) enclosures.
1, Providence River, 1883.

PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Under appropriation made by act of Congress of August 2d, 1882, a contract has been made for dredging a channel 25 feet deep at mean low-water at 16 cents per cubic yard. There have been dredged under this contract up to January 1st, about 200,000 cubic yards.

It is expected that the funds available will secure a channel 200 feet wide and 25 feet deep from Fox Point to the sea, and that it will be completed by Dec. 1st, 1883.

PAWTUCKET RIVER, RHODE ISLAND.

Nothing has been done on the improvement of this river since June 30, 1882.

By act of Congress of August 2d, 1882, the Secretary of War was directed at his discretion to cause a survey of this river and estimates of the cost of the improvement proper to be made.

A preliminary examination and report were made by Maj. J. W. Barlow, United States Engineers, while temporarily in charge of the works of this district after the death of General Warren.

The survey and estimates have not yet been ordered.

PAWTUXET RIVER, RHODE ISLAND.

By act of Congress of August 2d, 1882, the Secretary of War was directed at his discretion to cause an examination or survey of this river or both, and estimates of cost of the improvements proper to be made.

A preliminary examination and report were made by Maj. J. W. Barlow while temporarily in charge of the works of this district after the death of General Warren.

The survey and estimates have not yet been ordered.

BISSELL'S COVE, RHODE ISLAND.

By act of Congress of August 2d. 1882, the Secretary of War was directed at his discretion to cause an examination or survey of this cove or both, and estimates of cost of the improvement proper to be made.

A preliminary examination and report were made by Maj. J. W. Barlow, United States Engineers, while temporarily in charge of the works of this district after the death of General Warren.

The survey and estimates have not yet been ordered.

NEWPORT HARBOR, RHODE ISLAND.

Since June 30, 1882, the contract for dredging then in force has been completed. Another contract has been entered into for continuing the improvement by dredging at 24¼ cents per cubic yard and work commenced. The total amount of material removed since June 30 is 33,680 cubic yards.

It is probable that the funds available for this improvement will be expended by April 1st, 1883.

LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

A contract has been made for dredging at 20 9-10 cents per cubic yard to increase the width of the 7½ foot channel between Pawcatuck Point and Rhodes' Folly under the appropriation made by act of August 2, 1882.

Work was commenced in November, and 3321½ cubic yards removed.

Work will be resumed as soon as the weather will permit in the spring, and the funds available will be expended by June 30, 1883.

BLOCK ISLAND, RHODE ISLAND.

Plans for the expenditure of the funds appropriated for this work by act of Congress of August 2, 1882, have been prepared.

It is expected that the work will be completed by June 30, 1883.

BUSINESS OF PAWTUCKET.

An effort was made in December to ascertain approximately the amount of material in tons annually handled by the business men of Pawtucket. The information was sought by the Business Men's Association, for the purpose, mainly, of indicating the importance of unimpeded navigation to that town. Four hundred and fifty-eight circulars were sent, to which a response was expected in each case. Only one hundred and four replied. The information sought is therefore far from as complete as was expected. Some of the larger establishments made no return. The gross amount returned reaches about 280,000 tons of various kinds of material.

Below is a copy of the circular and partial copy of blank with aggregate of the returns received:

PAWTUCKET, R. I., Dec. 15, 1882.

At the suggestion of persons in position to aid in legislation, the Pawtucket Business Men's Association desire, in the interest of this community, to ascertain as nearly as can be done conveniently, the amount of business that is transacted by this community in tonnage. We enclose herewith a blank which we wish you would fill out with the amount of all material received and all that is sent away, manufactured or otherwise, however received or sent. This report will be made in gross, and nothing but the total tonnage will be known outside of this committee, so that there may be no hesitation in filling the blank, as the amount of private business will not be revealed.

As this is of some importance to all, it is desirable that this may be done at once in order to acquire the information at an early day.

Please place the blank when filled, inside the enclosed stamped envelope, and drop it in the post office,

and oblige,

GEO. E. NEWELL,
OLNEY ARNOLD,
E. L. FREEMAN,
} *Committee.*

DESCRIPTION.	TONS.	BARRELS.	FEET.
Cotton	15,230		
Coal	107,190		
Wool	511		
Iron	7,403		
Brick			2,806,000
Lime		3,690	
Cement		13,000	
Sand	1,475		
Gravel			
Flour		17,940	
Lumber			24,455,994
Cloth	11,603		
Hay	3,087		
Paper	487		
Other Material	98,654		

NUMBER OF VESSELS PASSING THROUGH DRAWBRIDGES IN PROVIDENCE.

CITY ENGINEER'S OFFICE,
Providence, R. I.

The following tables show the number of each kind, and the total number of vessels that passed through the drawbridges during the year 1882:

POINT STREET BRIDGE.

MONTHS.	Steamboats.	Towboats.	Sailing vessels.	Sailboats.	Miscellaneous.	Totals for the year.
January	161	1,053	221	287	114	1,836
February	152	840	166	267	74	1,499
March	171	1,028	318	490	88	2,095
April	185	1,147	387	546	161	2,426
May	307	1,205	421	719	213	2,865
June	609	1,339	442	906	350	3,646
July	1,298	1,184	366	883	246	3,977
August	1,295	1,450	463	939	301	4,448
September	796	1,348	347	751	457	3,699
October	191	1,335	421	652	350	2,949
November	168	1,043	399	453	227	2,290
December	150	1,137	312	348	201	2,148
Totals	5,483	14,109	4,263	7,241	2,782	33,878

CENTRAL BRIDGE.

MONTHS.	Steamboats.	Towboats.	Sailing vessels.	Sailboats.	Miscellaneous.	Total crafts for the year.
January	....	28	5	....	18	61
February	....	12	....	....	7	19
March	....	46	19	....	22	87
April	....	70	37	1	31	139
May	....	58	31	30	37	156
June	41	75	42	46	41	245
July	156	70	37	81	48	392
August	153	83	87	43	42	408
September	43	60	21	28	35	187
October	6	102	60	15	73	256
November	3	88	51	4	65	211
December	....	68	23	....	39	130
Totals	402	760	413	248	458	2,281

NO VESSELS PASSING THROUGH DRAWBRIDGES, ETC.—Continued.

WASHINGTON BRIDGE, AT INDIA POINT.

MONTHS.	Steamboats.	Towboats.	Sailing vessels.	Sailboats.	Miscellaneous.	Total crafts for the year.
January	....	36	9	3	17	65
February	....	14	1	2	8	25
March	....	60	29	5	22	116
April	......	76	43	11	38	163
May	....	76	41	34	36	187
June	36	112	64	63	40	315
July	155	74	42	104	52	427
August	153	100	89	67	47	456
September	43	61	24	60	32	220
October	6	105	59	73	71	314
November	3	96	58	30	68	255
December	....	70	24	1	37	132
Totals	396	880	483	453	468	2,675

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State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1884.

PROVIDENCE:
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The Commissioners.

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Eighth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, appointed Henry C. Bradford, of Providence, to be Harbor Commissioner for three years. Mr. Bradford assumed his duties on the first of July, that date being regarded as the beginning of the Commissioners' year.

HARBOR LINES.

After hearing all parties interested, as required by law, a harbor line was reported to the Governor and Senate for the west side of Pawtucket river from Bensley's Point to Red Bridge, and it was established on the seventh of March.

On the twelfth of April a harbor line, to be a substitute for that formerly existing, was established on the west side of Providence river from Point street to Henderson street. In all cases where harbor lines are reported for territory on which harbor lines had previously existed, an Act of the General Assembly is passed for their establishment.

In response to an order of the previous General Assembly, surveys have been made, and the Commissioners are engaged in designing a harbor line in Wickford Harbor from Quonset Point to Bissell's Cove. A report upon this matter may be expected during the present session.

Some doubt exists as to the exact location of the harbor line between Fox Point and India Point in Providence, owing to an apparent error in the plan referred to in the Act establishing the line, and surveys looking to a proposed re-establishment of the line have been ordered. A report upon this matter may be expected.

ENCROACHMENTS AND DUMPING.

The usual care has been required during the year to prevent encroachments, obstructions, and unauthorized dumping. The general dumping ground continues to be in deep water near Half-way Rock, east of Conanicut Island. Permission to dump a small amount, under restrictions, on the west side of Providence harbor, has been given. Orders for the removal of obstructions have been given as required.

Under a contract approved by the Attorney-General, the city of Providence is bound to do certain dredging as required by the Commissioners in compensation for obstructions caused by filling near Bird street on the Brook street district. No action has yet been taken to require this dredging, for the reason that the work can be much more satisfactorily defined after the replacing of Washington Bridge.

The Richmond Paper Company are building a dam across the mouth of Omega Cove, under the Railroad bridge in East Providence, cutting off a considerable volume of tide water. The work was well under way before coming to the attention of the Commissioners. The proceeding is unauthorized, but large interests are involved, and the work appears to have been innocently undertaken by the company. After several hearings and a view of the premises, the Commissioners decided, with the approval of the Attorney-General, to take an agreement, in the nature of a bond, from responsible persons, that, failing action on the matter by the General Assembly, the tidal flow shall be completely restored before the first of September next, and in consideration thereof to delay action against the company until the meeting of the General Assembly.

LICENSES, ETC.

Licenses have been issued as follows:

1. January 6, to the Boston and Providence Railroad Company for the reconstruction, under conditions, of the draw in their bridge at India Point.
2. January 16, to the Providence and Worcester Railroad Company for the construction of a pier in East Providence.
3. February 7, to James C. Goff for the erection of a wharf on the estate of the late George W. Hall on the east side of Providence river.
4. April 25, to the Providence Gas Company to rebuild their bridge wharf near the foot of Langley street in Providence.
5. May 9, to R. B. Little & Co. for extension of their wharf near Point street in Providence.
6. May 9, to C. B. Manchester and A. H. Manchester to repair their wharf near the foot of Manchester street in Providence.
7. June 12, to the Narragansett Boat Club for the erection of boat house and guards in Pawtucket river near the foot of Angell street.
8. June 12, to David Atwood to build a wharf in Barrington.
9. July 5, to Moncrieff & McLay for the construction of a wharf near Division street bridge in Pawtucket.

Assent has been given as follows:

1. May 23, to the Providence, Warren and Bristol Railroad Company for repairing their wharf at Bristol.
2. June 12, to the National Rubber Company at Bristol for the extension of their wharf.
3. July 25, to the Bay Mill Company for rebuilding their wharf at East Greenwich.
4. October 24, to Wm. M. Bailey for filling a lot of land near Gano and Preston streets in Providence.

5. December 5, to Robert Pettis for the extension of his wharf at Starvegoat Island.

HEARINGS, ETC.

In addition to the ordinary hearings at the regular meetings of the board, public hearings have been held as follows: January 6, in relation to the bridge of the Boston and Providence Railroad Company at India Point. February 28, in relation to a harbor line from Point street to Henderson street in Providence. June 12, at Wickford, in relation to a harbor line for Wickford harbor. June 21, in relation to proposed action by the city of Providence in reference to the reconstruction of Washington bridge, the Harbor Commissioners declining to approve the action.

JURISDICTION.

The waters immediately bordering upon the towns in Newport and Washington counties and the harbors of those counties are not within the jurisdiction of the Harbor Commissioners. Complaints have, however, been made by citizens of Westerly relative to encroachments on the river, and the attention of the Commissioners has been invited to the subject by officers of the U. S. Engineering Department. No action can be taken by the Commissioners unless the General Assembly extends their powers over those waters.

Application by numerous citizens of Wickford for the establishment of a harbor line in Wickford harbor was necessarily refused for want of jurisdiction. In this case, however, the Commissioners are designing a harbor line under a special Act of the General Assembly.

DRAW BRIDGES.

The Commissioners renew their suggestion that further legislation is needed to regulate the times for opening draw-bridges, and as to blocking the approaches to draws.

BOUNDARY LINE.

It seems desirable that the boundary line of tide water between the State of Massachusetts and Rhode Island should be defined by law.

Action in this matter has been taken in Massachusetts, and an Act was passed by the Senate of the last General Assembly, but no action has yet been taken by the House.

WORK UNDER LIGHTHOUSE BOARD.

A new lighthouse to be known as Sakonnet Light-Station is established on Little Cormorant Rock about nine hundred feet north-west of West Island, near Sakonnet Point, on the east side of the mouth of Sakonnet river, where a lighthouse is now building by the General Government. This will make the number of lights in Rhode Island waters and Narragansett Bay twenty-six.

WORK UNDER U. S. ENGINEER.

The work under the Engineer Department of the U. S. Government in Rhode Island waters has been prosecuted by Col. George H. Elliot, who divides the deep channel work into reaches, of which the upper three, viz. the Fox Point, the Sassafras Point, and the Field's Point, have been excavated 25 feet deep to the full proposed width of 300 feet; and the lower three reaches, viz. the Pomham, the Pawtuxet, and the Gaspee, have not less than 200 feet of the proposed width of 300 feet and depth of 25 feet.

The survey of Pawtucket river has been executed. The jetty on the south-east shore of Block Island and the harbor wall in the Inner Harbor of Refuge have been completed.

By the courtesy of Col. Elliot we have been furnished with a report of the work done in Rhode Island waters since June 30, 1883, which will be found in the appendix, together with extracts from reports of Col. Elliot to the Chief of Engineers, U. S. A., in relation to a survey of Pawtucket river and in relation to the ordinary work under his charge previous to July, 1883.

Respectfully submitted,

J. HERBERT SHEDD,
LUCIUS B. DARLING, } Harbor Commissioners.
HENRY C. BRADFORD,

APPENDIX.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., January 2, 1884.

J. HERBERT SHEDD, Esq.,
Prest. State Board Harbor Commrs., Providence, R. I.

SIR: I take pleasure in complying with your request of yesterday for a résumé of my works in Rhode Island since the date of my last annual report to the Chief of Engineers, U. S. Army.

These works are as follow:

Providence River and Narragansett Bay.
Pawtucket River.
Newport Harbor.
Block Island Harbor.
Little Narragansett Bay.

1st. *Providence River and Narragansett Bay.*

The report just mentioned brought the work down to the 1st of July last, and we were then at work on the Pawtuxet reach of our 25 foot channel. A width of 200 feet having been gained in this reach, the Fox Point reach was enlarged from 180 feet to the full width of 300 feet; the Sassafras Point reach from 230 feet to 300 feet; the Field's Point reach from 200 feet to 300 feet; and the work of widening and straightening the 25 foot channel in the Pomham reach had been commenced when the contract under the last appropriation by Congress, for the improvement of Providence River, was completed on the 21st of November last.

In addition to the above there were removed between the eastern limit of the 25 foot channel in the Field's Point reach and a line 150 feet eastward of this channel 43,016 cubic yards of material.

Everything in this area that was found dredgable, above a depth of 20 feet below mean low water, was removed; but on a part of "Long Bed" which projects into it from the eastward, the bottom was found extremely hard and could not be dredged to the full depth of 20 feet. My assistant, Mr. Eayrs, who subsequently made a careful survey of the areas dredged during the last season, reported that he found ledge rock underlying this shoal and projecting slightly into the 25 foot channel, but so close to the eastern side and so deep that it will not interfere with its full use.

From the above, and from the report above referred to, of which I had the honor to send you a printed copy, you will observe that the upper three of the straight reaches into which I have divided the new 25 foot channel, viz.: the Fox Point reach, the Sassafras Point reach and the Field's Point reach, have been excavated to the full width of 300 feet; and that in the lower three reaches of this channel, viz.: the Pombam reach, the Pawtuxet reach and the Gaspee reach, we have now not less than 200 feet of the projected width of 300 feet.

2d. *Pawtucket River.*

The survey of this river, directed in the River and Harbor Act of August 2, 1882, has been executed, and as soon as I receive copies of my printed report I will send you one.

3d. *Newport Harbor.*

No work has been done in this harbor since the completion of the last contract, on June 20, 1883, for want of funds.

4th. *Block Island Harbor.*

The jetty on the south-east shore of the island, and the harbor wall in the Inner Harbor of Refuge, referred to in my last annual report to the Chief of Engineers, have been completed.

5th. *Little Narragansett Bay.*

No work has been done in this bay since the completion of the last contract and of the project for improvement, on May 26, 1883, except the removal of all of the bowlders left in the dredged channel, and of a large number from the Watch Hill channel, leaving the latter channel in a greatly improved condition.

Very respectfully,

GEORGE H. ELLIOT,

Lieut.-Col. of Engineers.

EXTRACT FROM REPORT ON THE SURVEY OF PAWTUCKET RIVER.

Preliminary Examination of Pawtucket River, Rhode Island.

NEW LONDON, CONN.,
November 8, 1882.

This river was surveyed in 1870 and 1878, besides which partial examinations were made in 1872 in connection with improvements then in progress, and in 1879 very complete tidal observations were made, chiefly with the object of determining the influence of three bridges on the currents of the river. With the information obtainable from the maps and reports of these surveys and improvements a preliminary examination of the locality seems unnecessary.

Since 1867, $52,000 has been appropriated for this improvement, making the depth of channel 7 feet at mean low water, where the available depth had been 4½ feet. The dredged channel is 75 feet wide. The mean rise of tide is about 5 feet.

The last appropriation made for the Pawtucket River was in 1873. Since its expenditure the business of Pawtucket has greatly increased, and there is a demand for a channel of greater depth and width.

It is to obtain a project with estimates for an enlarged channel that this survey is desired.

Pawtucket is a manufacturing place of about 30,000 population; the improvement desired would be of general benefit to the community, and is undoubtedly one worthy to be made, and the work a public necessity, if the cost be not unduly great. This latter can be satisfactorily determined only by survey.

In my judgment, the survey ought to be made, and I recommend an allotment of $500 from the general appropriation for surveys for this purpose. If the field-work is to be done this fall, the allotment should be made by telegraph.

Respectfully submitted,

J. W. BARLOW,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers.

Survey of Pawtucket River, Rhode Island.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., November 8, 1383.

GENERAL: I have the honor to submit herewith a plat of the survey of Pawtucket River, Rhode Island, and estimates of cost of its improvement which were authorized by the river and harbor act of Congress of August 2, 1882, and placed in my charge by your instructions of April 24, 1883.

DESCRIPTION OF THE RIVER.

Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a distance of about 4½ miles, and forms a tidal basin of about 1¼ square miles. The mean rise and fall of the tide is about 5 feet. The continuation of the river above Pawtucket is called the Blackstone River, and is not navigable. At the mouth of the Pawtucket it is spanned by two bridges, parallel and about 250 feet apart. The upper, the old Washington Bridge, is a highway bridge, and the other is a railroad bridge belonging to the Boston and Providence Railroad Company. The draw of the Washington Bridge is close to the eastern shore, and is so narrow and illy located and constructed as to render navigation through it difficult and dangerous. By reason of this obstruction to the navigation of Pawtucket River, my predecessor, the late General Warren, declined for several years before his death, in August of last year, to estimate for further appropriations for its improvement; but the legislature of the State of Rhode Island, at its January session of this year, enacted a law by which a new drawbridge is to be built on or near the site of the present bridge. This law requires that the bridge shall be completed within two years from the appointment of a board of commissioners; that it shall have a swing draw with two openings of not less than 80 feet wide each, and that the channel of the river under and around the present bridge shall be cleared of all obstructions to the tidal flow to a depth of 15 feet below mean low water.

The railroad bridge does not seriously obstruct the tidal flow on which the maintenance of the channel of the Pawtucket depends, but the draw of this bridge is also badly located, and is too narrow. The draw openings are only 60 feet wide, and fender piles reduce the available width to about 47 feet. It is probable that when Washington Bridge is rebuilt the navigation interests and the town of Pawtucket will demand and effect an amelioration of the draw of the railroad bridge.

About four-fifths of a mile above Washington Bridge is Red Bridge, with two draw openings of 80 feet wide each. These openings were dredged in 1875 to a depth of 12 feet at mean low water.

The natural channel of the Pawtucket before improvement had a ruling depth of about 5 feet at mean low water. From 1868 to 1875 this channel was dredged to a width of 75 feet, and to a ruling depth of 7 feet at mean low water, under several small appropriations, amounting in all to $52,000.

SURVEY OF 1883.

The recent survey was commenced in the latter part of August last by Mr. W. H. Lawton, jr., assistant engineer, and a party in the United States schooner Surveyor. The entire river from Red Bridge to Pawtucket Bridge was first covered by a system of triangulation. In the subsequent sounding operations, the location of each sounding was determined by two angles turned from the sides of the triangles which were used as bases.

After the completion of the soundings the Surveyor was again sent to the river with a boring party under the charge of Mr. John S. Engs, jr. Mr. Engs, with the assistance of Captain Case and the crew of the schooner, made a large number of borings in the bed of the river, the results of which will be found in tabular form on the plat of the survey. Each boring was located in the same manner as the soundings, and was driven to a depth of 12 feet below mean low water except when stopped by ledge rock. In such cases, a few of which occurred in the upper part of the survey, the table of borings shows the depth to the ledge. In connection with the soundings the borings enable us to form a very close estimate of the quantities of materials of various kinds necessary to be removed in the improvement of the river, and in case of further appropriations for the work they will be of service to ourselves and to bidders in estimating the cost of dredging the sections into which the channel may be divided for contract.

The river having been carefully surveyed in 1873 by Mr. H. A. Bentley, assistant engineer, under the direction of the late General Warren, I deemed it unnecessary to run the shore lines again, or to sound out the broad areas of shallow water which occupy a large portion of the river between Pawtucket and its mouth. The *shore lines* on the plat herewith, except above the gas company's wharf, have, therefore, been taken from the plat of the former survey.

CHANGES SINCE THE SURVEY OF 1873.

At Red Bridge the eastern passage of the draw, which was dredged to 12 feet at mean low water in 1873, has more than kept its depth. The least depth now existing in that passage is 18.7 feet at mean low water. In the western passage the depth remains practically the same as in 1873.

From Red Bridge northward to opposite the north end of Sand Point the channel remains practically in its position of 1873, and carries the same depth except at the red buoy southwest of Narragansett Boat Club house, where a slight shoaling of about five-tenths of a foot has taken place for about 400 feet.

Opposite the north end of Sand Point the 9-foot contour in the channel has moved down stream about 800 feet. The 6-foot contours remain about the same as in 1873.

Between Sand Point and Swan Point wharf the channel remains the same as in 1873, except that the 6-foot contours have moved slightly towards the right or west bank of the river, and a shoaling of from 1 to 2 feet for about 300 feet has occurred just north of Butler Asylum wharf.

Shoaling has occurred in the channel off Swan Point wharf. The portion of the channel southwest of Swan Point wharf, which was dredged to 9 feet at mean low water in 1873, has now a maximum depth of 7 feet at mean low water. Off the northwest corner of Swan Point wharf the channel, dredged to 9 feet at mean low water in 1873, has filled about 2 feet on the average.

From Bucklin's Island to the wharf of the Pawtucket Gas Company there has been a general shoaling of the channel from 1 to 2 feet. The most marked change in this part of the channel is shown between Bishop's Point and Dunnell's wharf, where the depths of water in the portions dredged in 1873 to 9 feet at mean low water now run from a least depth of 4½ feet to a greatest depth of 7½ feet at mean low water, although between 6 and 7 feet can still be carried through this part of the channel.

The most marked filling has taken place, for a short distance, opposite the north side of the Pawtucket Gas Company's wharf. Here the channel has been crowded over close to the western bank by the shoal formed by deposits brought down by a sewer on the east bank of the river. In 1873 a cut was dredged to 7 feet at mean low water; this has been filled from 2 to 3 feet.

Dredging has been done from time to time, by private individuals, between the gas company's wharf and Pawtucket Bridge, and no useful comparison can be made in this part of the river between the surveys of 1873 and 1883.

PRESENT CONDITION OF THE CHANNEL.

It will be observed from the above and from an inspection of the plat of the recent survey, that the deposits in the channel since 1873, or during an interval of ten years, are not excessive; that the channel which had been dredged from a ruling depth of 5 feet to one of 7 feet at mean low water has held its own as well as could be expected, and that a draught of from 6 to 7 feet can still be carried at mean low water from Pawtucket to the mouth of the river, although the channel is narrow and in some places tortuous.

MATERIAL OF THE BED OF THE CHANNEL TO A DEPTH OF 12 FEET BELOW MEAN LOW WATER.

The tabular statement found on the plat of the results of the borings in the bed of the channel shows that in going up river from the deep water near Red Bridge to Swan Point, a distance of about 6,500 feet, the material is almost entirely mud; from Swan Point to a point opposite Grant & Co.'s wharf, at Pawtucket, a distance of about 9,000 feet, the material is mainly gravel and sand, interspersed in the upper part of this distance with stones; thence to Pawtucket Bridge, a distance of 750 feet (from boring 82), we find ledge rock appearing at depths less than 12 feet at mean low water. Seal Rock, a part of this ledge, projects into the channel in front of Grant & Co.'s wharf. The top of this rock is 2¼ feet above mean low water, and a large part of it must be removed in carrying out any scheme for the improvement of the upper part of the river.

THE REASONS FOR THE DEMAND FOR FURTHER IMPROVEMENT OF THE RIVER AND THE AMOUNT OF COMMERCE INTERESTED.

The reasons for the demand for an increased width and depth of channel and the amount of commerce interested are fully set forth in the letters from the Business Men's Association of Pawtucket, which will be found appended to this report.

The statements contained in these letters are believed to be substantially correct.

ESTIMATES OF THE COST OF IMPROVEMENT.

It will be observed that the business men of Pawtucket desire a channel with a minimum width of 150 feet and 12 feet deep at mean low water, and I have prepared an estimate of the cost of such a channel extending from the deep water just above Red Bridge to a point in the natural channel where the ledge rock appears at depths less than 12 feet below mean low water. This, as before stated, is opposite Grant & Co.'s wharf, and about 750 feet below the bridge at Pawtucket. From this point to the bridge I have estimated for a channel in rock cutting 40 feet wide and to a depth of 12 feet at mean low water.

The excavation, at the expense of General Government, of a *wide* channel through the rock which lies between the wharves on either side of the river is probably out of the question on account of the expense, and, in my judgment, is not necessary, since the river here is very narrow. The proposed rock cutting is short, and there are on the east side, as will be observed on the plat, two natural side pockets or basins of 12 feet depth and more, one at the mouth of the proposed narrow channel and the other about midway to the bridge, where vessels can lie when waiting to pass or to get to their berths at the wharves. These waiting basins would, I think, be found quite sufficient in size, since vessels destined for Pawtucket, as a general rule, remain in Providence River until their berths at Pawtucket are ready for them.

The channel through the rock, of the dimensions above stated, being furnished at the expense of General Government, the remainder of the expense necessary for providing means to get deep-draught vessels to the wharves, namely, the berths at the wharves and communications from them to the channel would doubtless be provided for by the wharf-owners.

The following is the estimate above referred to:

MAIN CHANNEL 12 FEET DEEP AT MEAN LOW WATER, AND 150 FEET WIDE FROM RED BRIDGE TO THE LEDGE OPPOSITE GRANT & CO.'S WHARF, THENCE TO PAWTUCKET BRIDGE 40 FEET WIDE.

Mud excavation, 246,667 cubic yards, at 35 cents	$86,333
Gravel and sand excavation, 388,000 cubic yards, at 50 cents	194,000
Rock excavation, 5,467 cubic yards, at $35	191,345
	$471,678

I have estimated the costs of channels of other widths and depths, the depth of rock cutting in each case being the depth of the main channel below, and they are as follows:

MAIN CHANNEL 100 FEET WIDE AND 12 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 148,000 cubic yards, at 35 cents	$51,800
Gravel and sand excavation, 278,667 cubic yards, at 50 cents	139,333
Rock excavation, 5,467 cubic yards, at $35	191,345
	$382,478

MAIN CHANNEL 150 FEET WIDE AND 10 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 150,667 cubic yards, at 35 cents	$52,733
Gravel and sand excavation, 266,667 cubic yards, at 50 cents	133,334
Rock excavation, 3,400 cubic yards, at $35	119,000
	$305,067

MAIN CHANNEL 100 FEET WIDE AND 10 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 93,333 cubic yards, at 35 cents	$32,666
Gravel and sand excavation, 186,667 cubic yards, at 50 cents	93,334
Rock excavation, 3,400 cubic yards, at $35	119,000
	$245,000

A depth of 12 feet at mean low water (17 feet at mean high water) is doubtless required for the commerce of Pawtucket, and if we make a channel of this depth it would probably be sufficient for many years to come. I am inclined to doubt, however, the necessity for making the width of channel as great as 150 feet, since the freights between the port of Providence and Pawtucket are almost exclusively propelled by steam. If the width in the first instance be made 100 feet; if we cut off the angles so as to widen the channel at these points, and place good range beacons on the shores of the river for marking the axes of the different reaches of the channel, I think it will be sufficient for the present.

My judgment is, therefore, that the "improvement proper to be made" in this case is a channel 12 feet deep at mean low water, 100 feet wide from Red Bridge to the ledge opposite Grant & Co.'s wharf, thence 40 feet wide to Pawtucket Bridge.

The estimate of the cost of this improvement is $382,478.

In view of the serious obstruction to the navigation of Pawtucket River by the present Washington Bridge, and of the delay in the appointment of two of the commissioners, under the recent act of the legislature of Rhode Island, which provides for the rebuilding of this bridge with proper draw openings and the removal of stone and other materials which have been deposited under and above it, it is recommended that the first appropriation for the work be accompanied by the following proviso:

Provided that this appropriation shall not become available until the officer in charge shall have reported that the rebuilding of Washington Bridge with good and sufficient draw openings has been commenced.

It should be remarked, in conclusion, that in estimating the cost of the work allowance has been made for the difficulty of getting tows of scows containing the excavated material through the bridges near the mouth of the river, and for the long distance which they must be taken for dumping. The soft material should not in any case be dumped where it will be carried back into the channels to be excavated in this river and now excavated in Providence River. Possibly it may be safe to dump the gravel in the shoal places of Pawtucket River, but probably the whole of the excavated material will have to be towed to the dumping ground below Prudence Island in Narragansett Bay, in the vicinity of Half Way Rock, which is now used in the improvement of Providence River, an average distance of about 22 miles.

Respectfully submitted,

GEORGE H. ELLIOT,
Lieut. Col. of Engineers.

Brig. Gen. H. G. Wright,
Chief of Engineers, U. S. A.

EXTRACT FROM COL. ELLIOT'S ANNUAL REPORT TO CHIEF OF ENGINEERS, U. S. A., FOR 1883.

Improvement of Pawtucket (Seekonk) River, Rhode Island.

The project as far as adopted and approved was completed some years since.

The mouth of the river is obstructed by two bridges with badly arranged draws; but Washington Bridge, which interferes with navigation more than the other (the railroad bridge), is to be rebuilt under an act passed by the legislature of Rhode Island at the January session of 1883, and the obstruction caused by this bridge, which has heretofore been a bar to recommendations by the engineer officer in charge of the district for further appropriations for the improvement of the river, will now be removed.

The following is an extract from the act referred to:

An Act providing for clearing the channel of the Seekonk River, at India Point, in Providence, of obstructions; and for the construction of a bridge near the site of the Providence Washington Bridge.

It is enacted by the General Assembly as follows:

Section 1. The city of Providence may elect, on or before the first day of July, A. D. 1883, to remove forthwith the stone and other materials deposited in the Seekonk River under and near Washington Bridge, so called, at India Point, in said city, from said river, and cause the channel thereof under and around said bridge to be dredged and cleared of all obstructions to the flow of the tides into and out of said river, to a depth of 15 feet at low-water, and reconstruct said bridge with a swing-draw in the main channel of said river, with an opening on each side of said draw, not less than 80 feet wide, for the safe and convenient passage of vessels navigating said river, through the same, in such manner as the harbor commissioners shall approve.

SEC. 2. If the said city council shall elect within the time limited in the preceeding section, to dredge and clear the channel of said river and reconstruct said Washington Bridge in the manner prescribed in said section. the city shall cause said work to be completed to the satisfaction of the harbor commissioners within one year from the time such election shall be made by said city council, and the obligations of said city under an act entitled "An act in relation to the Providence Washington Bridge and the draws in the bridges of the Seekonk River," passed at the January session, 1859, and accepted by said city April 12, 1859, to maintain and keep in repair said Washington Bridge and draw, shall remain in full force in respect to said reconstructed bridge and draw.

SEC. 3. If the city council of the city of Providence shall not elect within the time limited in section 1, to reconstruct said Washington Bridge in the manner aforesaid, a new bridge over said river, on or near the site of said Washington Bridge, shall be built with a swing-draw therein with an opening on each side of said draw not less than 80 feet wide, so located with reference to the channel and currents of the river as to be most safe and convenient for the passage of vessels navigating said river, through the same, in such place and manner as shall be determined by five bridge commissioners, of whom two shall be appointed by the city council of said city, two by the governor, and one by the town council of the town of East Providence. And if said new bridge shall be constructed upon the site of the present Washington Bridge, the said commissioners shall first remove said Washington Bridge and dredge and clear the channel under and near the same, of all obstructions to the flow of the tides and to navigation, to a depth of not less than 15 feet at low water.

SEC. 4. The bridge commissioners so appointed shall cause within two years from the time of their appointment said new bridge to be constructed and completed according to plans and specifications by them approved, and when the same shall be completed and opened for public travel, the said commissioners, in case said bridge shall be on a site other than that of the present Washington Bridge, shall cause the present Washington Bridge to be removed from said river, together with the piers and piling thereof and connected therewith, and shall also cause the channel of said river to be dredged under and about said Washington Bridge and said new bridge, to a depth of not less than 15 feet at low-water, and in such manner as the harbor commissioners may direct, and deliver to said city the materials composing said bridge, piers and piling for the use of said city.

An allotment has been made from the appropriation for the examination and survey of rivers and harbors, contained in the act of Congress of August 2, 1882, for the survey of this river. The survey and report thereon will be made in time for action at the next session of Congress.

After the death of General Warren (August 8, 1882) this work was in temporary charge of Maj. J. W. Barlow, Corps of Engineers, until the 24th of November, 1882, when, by direction of the Secretary of War, it was transferred to Lieut. Col. George H. Elliot, Corps of Engineers.

Pawtucket is largely engaged in commerce and manufactures, and the larger size and draught of sailing vessels of late years makes it desirable that the navigable depth of the river should be increased.

Pawtucket River is in the Providence collection district, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $256,448.50. The nearest light-house is Sassafras Point light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort at Dutch Island, R. I.

MONEY STATEMENT.

July 1, 1882, amount available	$529 58
July 1, 1883, amount available	529 58

COMMERCIAL STATISTICS.

LETTERS OF PAWTUCKET BUSINESS MEN'S ASSOCIATION.

1.

PAWTUCKET, R. I., June 14, 1883.

DEAR SIR: Your favor of May 22, addressed to the Pawtucket Business Men's Association, was duly received, and the undersigned, a committee appointed by said association to obtain the information desired, most respectfully submit the following statistics of the commerce in Pawtucket River for the year 1882:

Imports.

Coal	tons	86,000
Iron	do.	5,300
Gravel	do.	300
Clay	do.	50
North River stone	do.	500
Paving Stone	do.	240
Brick		2,000,000
Ammonia water	barrels	210,000
Lime	do.	2,500
Cement	do.	15,000
Long lumber	feet	9,000,000
Short lumber, as shingles, laths, clapboards, &c.	do.	3,000,000
Spool lumber (about)	do.	2,000,000

The above merchandise was received chiefly by barges and sailing vessels carrying from 150 to 600 tons each, and drawing from 7½ to 11 feet of water.

The number of water-craft passed through the draw-bridges for the year 1882 was as follows:

Steamboats	402
Tow-boats	760
Sailing vessels	418
Sail-boats	248
Miscellaneous	458
Total	2,281

We would call attention to the fact that the commerce upon the river is steadily increasing; also that extensive manufacturing establishments are now being erected upon the banks of the river, which will greatly increase the commerce upon the same, and in order to meet the demand for transportation in large barges and sailing vessels increased facilities to navigate the Pawtucket River should be made by widening and deepening the channel and removing the obstructions.

We wish especially to call attention to an obstruction known as Seal Rock, lying nearly in the middle of the channel of the river at the head of navigation, and we hope that such recommendation will be made as will cause its removal.

All of which is most respectfully submitted.

GEO. E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee.

GEO. H. ELLIOT,
Lieut. Col. of Engineers, U. S. A.

2.

PAWTUCKET, August 2, 1883.

DEAR SIR: We, the undersigned committee, beg leave to submit the following supplemental report in accordance with your request to furnish additional information respecting the commerce and manufactures that would be benefited by further improvement of the Pawtucket River.

Pawtucket, situated at the head of navigation, 4 miles above Providence, becomes a distributing point for merchandise to supply an extensive inland trade. Among the towns which draw more or less of their supplies from Pawtucket may be mentioned East Providence, Seekonk, Rehoboth, Attleboro, Mansfield, Wrentham, Franklin, Cumberland, Lincoln, Smithfield, and North Providence.

Pawtucket naturally commands the trade of the territory for half the distance to Boston and entire valley of the Blackstone River. One hundred and thirty trains over Boston and Providence, the Providence and Worcester, and the New York and New England railroads pass through this place daily. Its convenience for transportation by rail, the facility with which its citizens can reach all the large centers of business, together with its manufacturing and mechanical industries, have attracted people from various parts of the world to settle here.

The growth of Pawtucket has been rapidly increasing. In 1865 there were 5,000 inhabitants; at the present time, 1883, there are between 23,000 and 25,000. If we include the immediate villages of Central Falls, Valley Falls, Lonsdale and Saylesville, we may safely say we have a population upwards of 35,000.

Within these limits there is a great variety and a vast amount of manufacturing and mechanical industries carried on, and from which the General Government has in years past received large revenues. They paid during the fiscal year ending June 30, 1866, $636,691.98 into the office of the assessors for internal revenue for the first district of Rhode Island.

The revenue from the Pawtucket post-office for the fiscal year ending December 31, 1882, was $12,298.28, which will give you some idea of the business which is transacted here at the present time.

Pawtucket is largely a manufacturing community, and in the extent and variety of its manufactures is not surpassed by any place of equal size in the United States. It contains some of the largest establishments of their kind which are to be found in the country, among which may be mentioned the Conant Thread Company, manufacturers of the J. & P. Coats spool cotton, with a capital of $3,000,000, and employing over 2,000 operatives, and consuming in the single item of coal 20,000 tons annually.

The W. F. & F. C. Sayles bleacheries, with their manufacturing establishments, employ over 1,500 hands, and their consumption of coal per annum is 15,000 tons.

The Rhode Island Horse Shoe Company, situated in Valley Falls, in the immediate vicinity of this place, is the largest of its kind in the world, and calls for a transportation of 150 tons per day, with a consumption of 12,000 tons of coal per annum.

Without entering further into detail, would add that not less than $25,000,000 are invested in the different manufacturing industries, all of which could not fail of being benefited by the removal of the obstructions and the improvement of the channel of the Pawtucket River.

The specific improvements needed to put the river in proper condition are the removal of the obstructions at the Railroad and Washington Bridges, the straightening, widening, and deepening of the channel, so that when completed it shall have a width of 150 to 200 feet, and a depth of 12 feet at low-water; also the removal of Seal Rock, near the head of navigation.

Provision has been made by the State government for the removal of the present Washington Bridge and the obstructions under the same, making a depth of water of not less than 15 feet at low-water; also, providing for five commissioners, to be appointed by the State, the town of East Providence, and the city of Providence, to execute the foregoing provision, build a bridge in place of the present Washington Bridge with a draw having two openings of 80 feet in width, and two years' time has been allowed the commissioners for the completion of the work. Commissioners have already been appointed by the State and the town of East Providence.

All of which is most respectfully submitted,

GEO. E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee of Pawtucket Business Men's Association.

GEO. H. ELLIOT,
Lieut. Col. U. S. Engineers.

Improvement of Providence River and Narragansett Bay, Rhode Island.

At the date of the last annual report no work was in progress, the previous appropriation having become exhausted April 26, 1882.

By the act of Congress of August 2, 1882, $125,000 was appropriated for this work; and Maj. J. W. Barlow, Corps of Engineers, in temporary charge after the death of General Warren (August 8, 1882), submitted a project for its expenditure. This project, which was in accord with a project previously submitted by General Warren, contemplated the dredging of a channel 800 feet wide and 25 feet deep at mean low water from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and it was recommended that the whole sum of $125,000 be devoted to securing as much of this width of 800 feet as the money would pay for. The project was approved by the Chief of Engineers, and Major Barlow divided the proposed work into two sections — the first section being the portion of the river below Field's Point, and the second section being the portion of the river between Field's Point and Fox Point — with the design of making one contract for the whole work or separate contracts for the two sections, as the interests of the United States might require. Proposals for the work were invited by advertisement September 16, 1882, and the following were received and were opened October 10, 1882:

Names and addresses of bidders.	Price for both sections.	Date of commencement.	Date of completion.
	Per cub. yd.		
Atlantic Dredging Company, Brooklyn, N. Y.	$0 16	Nov. 1, 1882	Dec. 1, 1883
H. H. & A. J. Beardsley, Bridgeport, Conn.	17	Nov. 1, 1882	Dec. 1, 1883
Ross & Sandford, Jersey City, N. J.	17⅝	Nov. 1, 1882	Dec. 1, 1883
George E. Runyan, Portland, Me.	23	Nov. 1, 1882	Dec. 1, 1883

The contract, with the approval of the Chief of Engineers, was awarded to the Atlantic Dredging Company, the lowest bidder for both sections; date of contract October 30, 1882.

On the 24th of November, 1882, the work, by direction of the Secretary of War, was transferred to Lieut. Col. George H. Elliot, Corps of Engineers.

Dredging under the above contract had been commenced October 30, 1882, and it was carried on, with a few interruptions from ice, in dredging the Fox Point Channel, the Sassafras Point Channel, and that part of the Field's Point Channel which lies above Field's Point, until March 22, 1883. During this time 312,604 cubic yards were removed, making the following widths, viz: 180 feet in the Fox Point Channel; 230 feet in the Sassafras Point Channel; and 200 feet in the Field's Point Channel.

Work was then commenced at the Gaspee Channel. It continued until May 26, 1883, and 117,264 cubic yards were removed in making a width of 200 feet. The dredging machine was then removed to the Pawtuxet Channel, and work on it has continued to the end of the fiscal year. The width gained in this channel on the 30th of June, 1883, was 120 feet, and the quantity of material removed from it was 72,436 cubic yards.

Before determining the lines of the deep channels to be dredged below Field's Point, a survey of the river from that point to Conimicut Point was made, and these channels, as well as the 25-foot channels above Field's Point, have been laid out in the straight reaches before mentioned (with proper enlargement at the angles), with a view both to economy of excavation and facility of lighting them by a system of range or leading lights, such as have been found necessary in the navigation of the dredged channels in the Delaware River, Chesapeake Bay, and other localities. The Providence Board of Trade, adopting the suggestion, passed the following resolutions at its monthly meeting on the 1st of May last:

RESOLUTIONS UNANIMOUSLY PASSED BY THE PROVIDENCE BOARD OF TRADE AT ITS MONTHLY MEETING HELD MAY 1, 1883.

Whereas the expenditures of the United States Government for the improvement of Narragansett Bay and the approaches to Providence Harbor have resulted in securing channels 25 feet deep at mean low-water, and with a least width of 200 feet; and

Whereas the present location of buoys in Narragansett Bay do not sufficiently mark these recently-completed channels: Therefore be it

Resolved, That the Providence Board of Trade hereby urgently petitions the honorable Secretary of the Treasury of the United States to have said new channels properly buoyed to enable mariners to readily distinguish them during the day, and also to cause said channels to be marked by a suitable series of range lights that they may be safely run during the night. And be it further

Resolved, That this Board of Trade particularly request the Senators and Representatives in Congress from this State to make every effort to secure for said channels these additional guards against the dangers of navigation.

CHAS. H. MERRIMAN,
President.

FREEMAN P. LITTLE,
Secretary.

It is expected that the present appropriation will be sufficient to secure something in excess of the 200 of the 300 feet of width projected for the 25-foot channel from Fox Point to the deep water of Narragansett Bay. The remaining width of this deep-water channel, the unexecuted portion of the approved project for an anchorage basin above Field's Point, and the proper enlargement of the channel below Field's Point to accommodate the wants of coasting and local traffic, should be provided for by early additional appropriations.

In the adopted project for the anchorage basin between Fox Point and Field's Point the bottom was to be of the following form in cross section:

	Feet deep.
150 feet wide	23
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

This has been modified by the adoption of the project for a 25-foot channel, 300 feet wide, and the project for the basin above Field's Point now stands as follows:

	Feet deep.
300 feet wide	25
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

The estimated cost of the modified project, including the continuation of the 300-foot channel, 25 deep to deep water of Narragansett Bay, was $675,000.

Below Field's Point there has been no approved project of improvement other than that to secure a channel 300 feet wide and 25 feet deep, but from Sabin's light (the lower end of the Pawtuxet Channel) to Field's Point, the width of 300 feet will be insufficient to accommodate the increasing coasting and local traffic, and a plan has been prepared for an enlarged beating channel in this part of the river:

	Feet deep.
300 feet wide	25
500 feet wide	18
700 feet wide	14

With proper enlargements at the angles.

The estimated cost of this channel, excluding the cost of the 25-foot channel now in progress, is $115,000, making an estimated total cost for the entire river $790,000. Of this amount there has been appropriated $355,000, leaving $435,000 as the amount necessary to complete the improvement.

Since the improvement of Providence River was commenced by Lieutenant Rosecrans, United States Engineers, in 1853, the navigable depth has been increased from 4½ to 25 feet at mean low-water.

During the fiscal year until the 6th of June this work was under the immediate supervision of Assistant Engineer H. A. Bentley, and since that date of Assistant Engineer J. P. Cotton.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected during the last fiscal year was $286,443.80. The nearest light-houses are the six light-houses in Providence River The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1882, amount available		$3,464 49
Amount appropriated by act passed August 2, 1882		125,000 00
		128,464 49
July 1, 1883, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1882	$75,378 67	
July 1, 1883, outstanding liabilities	16,921 84	
		92,300 51
July 1, 1883, amount available		$36,163 98

Amount (estimated) required for completion of existing project	$320,000 00
Amount (estimated) required for additional work	115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1885	150,000 00

LETTER OF THE PRESIDENT OF THE BOARD OF TRADE OF PROVIDENCE, RHODE ISLAND.

PROVIDENCE BOARD OF TRADE,
SECRETARY'S OFFICE,
PROVIDENCE, R. I., June 5, 1883.

SIR: With this I have the honor to hand you some statistics of the port of Providence for the year 1882; also, copy of report made to me by Mr. C. H. Salisbury (the keeper of Pomham lights) of the number and character of vessels passing his lighthouse for several years. I send the report entire, as it will serve to illustrate the important fact that the increasing numbers of heavy-draught vessels, such as steamships and barges, has caused a decrease in the aggregate number of vessels entering the port. This is due in a great measure to the coaling business, which you will note by statistics attached is of great importance, and which formerly employed large numbers of small schooners and sloops, which are now being driven from the business by heavy-draught barges and three-masted schooners. This coaling business bids fair to increase largely in the near future, contracts having already been given out for better facilities for handling cargoes at our wharves.

It is difficult to give any statistics of the exports of this city. They are of great value, but consist largely of manufactures of iron, steel, cotton, wool, &c., and are shipped mainly by the steamship lines between this port and New York, Philadelphia, Baltimore, and Norfolk, which lines also transport large quantities of freight from the interior cities of New England such as Worcester, Nashua, Lowell, and Lawrence. There are no means of getting at the actual value of these exports, but they undoubtedly would aggregate several hundreds of millions of dollars annually.

In pursuing a liberal policy of improvement in our bay and harbor the General Government is not merely fostering a local interest. The merchants of all sections of the country have an interest in the matter, for merchandise from every State in the Union here finds a market or an outlet.

If I can be of any further service to you I shall be pleased to receive your commands, and am,

Your obedient servant,
CHAS. H. MERRIMAN,
President.

GEO. H. ELLIOT,
Lieut. Col. of Engineers.

P. S.—On reviewing my letter, it occurs to me that you may regard the statement of the immense value of the exports of this port as an exaggerated one. The estimate is intended, however, to cover the coastwise trade, and as the census of 1880 gives the value of manufactured goods as follows—

Massachusetts	$631,000,000
Vermont	31,000,000
New Hampshire	74,000,000
Rhode Island	104,000,000
Total	840,000,000

and the railroad lines terminating in Providence tap the manufacturing centres of these States, and bring immense quantities of their goods to the freight lines here, it appears that my figures are not unreasonable.

Very respectfully,

C. H. MERRIMAN.

STATISTICS OF THE PORT OF PROVIDENCE FOR YEAR 1882.

Vessels arrived from foreign countries, ninety-four, of which nineteen were American vessels.

Coastwise arrivals	5,014

Imports.

Lumber	feet	4,122,000
Shingles		6,111,000
Laths		10,866,000
Pickets		119,675
Potatoes	bushels	2,137
Salt	pounds	6,907,826
Logwood	do.	3,944,000
Scrap iron	tons	3,474
Brimstone	do.	1,244
Molasses	gallons	100,032
Cotton*	bales	189,526
Wool*	do.	39,226
Flour*	barrels	15,685
Grain*	bushels	1,275,902
Coal	tons	829,613

Tonnage of this Port December 31, 1882.

	Tons.
122 sail vessels	15,538.81
25 steamers	20,701.10

This does not include the great quantities of manufactured goods of States south of us which come through this port on their way to Boston and Central New England.

LIST OF VESSELS, INCLUDING STEAMERS, PASSING POMHAM ROCK LIGHT (SUNRISE TO SUNSET) FROM DECEMBER 10, 1871, TO SEPTEMBER 30, 1882.

December, 1871	350
Year 1872	13,789
Year 1873	17,406
Year 1874	16,115

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*These articles are also received very largely by railroad.

Year 1875	13,884
Year 1876	14,872
Year 1877	12,481
Year 1878	13,363
Year 1879	12,857
Year 1880	12,926
Year 1881	11,965
January 1 to September, 1882	9,071
Total	149,079

LETTER OF MR. GEORGE R. PHILLIPS.

PROVIDENCE, R. I., June 8, 1883.

DEAR SIR: With this I send you the commercial statistics of Providence for the year ending December 31, 1882, showing the imports of general merchandise, &c., which I hope will be satisfactory to you and give you the desired information.

* * * * * * * *

Very truly yours,

GEO. R. PHILLIPS.

Col. GEO. H. ELLIOT.

IMPORTS INTO THE PORT OF PROVIDENCE, RHODE ISLAND, FOR THE YEAR 1882.

Lumber	feet	24,520,980
Shingles		9,070,480
Pickets		1,611,655
Clapboards and laths		12,498,000
Bricks		22,000,000
Lime	casks	27,000
Cement	do.	31,500
Coal	tons	821,837
Cotton	bales	237,988
Wool	do.	100,484
Flour	barrels	258.085
Corn	bushels	1,658,091
Bran	do.	893,097
Oats	do.	460,064
Malt	do.	133,247
Meal	do.	6,865
Wheat and rye	do.	6,624
Salt	do.	90,000
Logwood	pounds	6,296,000
Brimstone	do.	1,500
Iron:		
Scrap	tons	5,500

Bar	do.	16,000	
Pig	do.	18,000	
			34,500
Molasses	hogsheads		14,000
Number of vessels arriving			5,094

NAMES OF STEAMERS RUNNING TO PROVIDENCE, AND DRAUGHT OF WATER.

	Draught, feet.
Wilkesbarre, carries 2,000 tons coal	22
Nianza, carries 1,800 tons iron	22
C. W. Lord, carries 900 tons coal	18½
Allentown, carries 1,900 tons coal	18
Redding, carries 1,850 tons coal	18
Pokomea, carries 1,400 tons coal	17
Kanawha, carries 850 tons coal	16
Panther, carries 1,000 tons coal	13
Centipede, carries 600 tons of coal	12
Berks, carries 900 tons coal	13
Rattlesnake, carries 600 tons coal	12
Blackstone	15
George Appold	18
William Kennedy	15
William Lawrence	16
Alleghany	21
Berkshire	21
C. Whiting	15
Tonawanda	16
Electra	15
Stonington	12
Narragansett	12

SAIL VESSELS.

Balch, four-masted, carries 1,400 tons	16
Church, four-masted, carries 1,800 tons.	17
Williams, three-masted, carries 1,400 tons	18
Lawrence, three-masted, carries 1,300 tons	16
Angell, three-masted, carries 1,310 tons	16
Phillips, three-masted, carries 1,300 tons	16
Briggs, carries 1,300 tons	16
Simmons, carries 1,200 tons	16
Walker, carries 1,260 tons	17

BARGES.

Cuba, carries 1,450 tons coal	18
Expounder, carries 1,400 tons	18½

Union, carries 1,440 tons coal	16½
Oceanic, carries 1,500 tons coal	17
Albemarle, carries 1,600 tons coal	17½
Hatteras, carries 1,600 tons coal	17

LETTER OF COLLECTOR OF CUSTOMS AT PROVIDENCE, RHODE ISLAND.

CUSTOM-HOUSE, PROVIDENCE, R. I.
Collector's Office, June 16, 1883.

SIR: I forward herewith statistics of commerce and navigation in this district, as requested in your letter of the 22d ultimo.

Respectfully,

CYRUS HARRIS,
Collector.

GEO. H. ELLIOT,
Lieut. Col. of Engineers.

RIVER STATISTICS OF THE PORT OF PROVIDENCE FOR THE YEAR 1882.

Tonnage of one hundred and twenty-two sail vessels said to belong to the port	15,538.81
Twenty-five steamers said to belong to the port	20,701.10
Total	36,239.91

Number of vessels that arrived at this port (foreign, 164; coastwise, 5,034)	5,198
To this should be added the vessels of 5 tons and upwards, but under 20 tons, that are constantly arriving with cargoes, but are not reported, forty-nine in number; also the class of steamers that are towing barges here and are not reported. An average tow of barges is three, and as eight hundred and thirty-two barges arrived here for the year, we have as an estimate for these arrivals	277
Total	5,475

Tonnage of reported arrivals ascertained by taking an average month, the month of April, with four hundred and twenty-nine arrivals, and finding the tonnage for same on Merchant List, then multiplying by twelve, thereby getting an estimate for the year (100 cubic feet to the ton), 1,866,528.36 tons.

To this should be added the tonnage of the above class of 5 tons and under 20 tons, the aggregate of which, 394.56 tons, multiplied by the many times arrived; also the class of steamers arriving, fourteen in number, with barges, whose aggregate tonnage is 1,510 tons, multiplied by estimated times of arrival, 277 by 108 tons, average 29,916 tons.

CLASS OF VESSELS AND NUMBER OF EACH CLASS.

Steamers	1,876	Sloops	135
Barks	9	Barges	832
Barkentines	3		
Brigs	14	Total	5,198
Schooners	2,329		

ARRIVALS OF ALL KINDS FOR EACH MONTH.

January	286	August	573
February	259	September	406
March	422	October	498
April	429	November	414
May	544	December	349
June	501		
July	517	Total	5,198

(Add estimated arrivals not reported.)

MERCHANDISE RECEIVED AT THIS PORT, TOGETHER WITH THAT SHIPPED BY STEAMERS ONLY; ALSO PASSENGERS CARRIED AND DRAUGHT OF WATER.

Norfolk and Baltimore line:

Tons of freight, 71,868; passengers, ——.

	Tonnage.	Draught, feet.
Steamer Blackstone	1,147.19	19
Steamer Berkshire	2,014.42	20 to 22
Steamer Alleghany	2,014.42	20 to 22
Steamer Wm. Kennedy	974.57	17
	6,150.60	
Steamer George Appold	1,456.19	18
Steamer McClellan	953.42	16
Now running here	2,409.61	

Winsor's line:

Tons of freight 62,400
Passengers .... None.

	Tonnage.	Draught, feet.
Steamer Catherine Whiting	880.63	15
Steamer Tonawanda	844.52	13

Providence line to New York and return:

Tons of freight 438,000
Passengers 29,137

	Tonnage.	Draught, feet.
Steamer Massachusetts	2,606.83	12
Steamer Rhode Island	2,888.20	12
Steamer Electra	1,566.70	14 to 17
Steamer Doris	1,360.25	14 to 17
Steamer Galatea	1,566.70	14 to 17
Steamer Thetis	1,360.25	14 to 17
Steamer Amos C. Barstow	268.13	12
Steamer Francis	988.18	6
	12,605.24	

Continental Steamboat Company:

	Tonnage.	Draught, feet.
Steamer Crystal Wave	777.55	7½
Steamer Day Star	681.61	6½
Steamer Bay Queen	679.51	6½
Steamer City of Newport	561.73	6½
Steamer What Cheer	214.98	4½
	2,915.38	

Tons of freight	21,900
Passengers	377,330

Fall River line:

	Tonnage.	Draught, feet.
Steamer Richard Borden	892.35	7
Steamer Canonicus	510.67	6½
Steamer Bradford Durfee	388.43	6
	1,791.45	

Tons of freight	36,500
Passengers	103,734

Steamer William Marvel:

Tonnage, 8,654; draught, 6½ to 8½ feet.

Tons of freight	22,000
Passengers	4,800

Steamer George W. Danielson:

Tonnage, 130.76; draught, 7 to 9 feet.

Tons of freight	5,000
Passengers	8,912

DRAUGHT OF OTHER VESSELS ARRIVING AT THIS PORT.

1. A class of sail vessels from 150 to 300 tons capacity; draught, from 10 to 13 feet.

2. A class of sail vessels from 400 to 700 tons capacity; draught, from 12 to 14½ and 15 feet.
3. A class of sail vessels from 800 to 1,300 tons capacity; draught, from 15 to 17½ and 18 feet.
4. A class of barges that were formerly steamers and ships: Barge Cuba, 1,400 tons capacity; draught, 18 to 19 feet. Barge Expounder, 1,500 tons capacity; draught, 19 feet. Barge Hatteras, 1,400 tons capacity; draught, 16 to 17 feet. Barge Albemarle, 1,450 tons capacity; draught, 16 to 17 feet.
5. A class of steamers: Wilkesbarre, 2,200 tons capacity; draught, 21½ feet. Reading, Allentown, Pottsville, Yorktown, 1,800 tons capacity; all drawing about 18½ feet. C. W. Lord, 900 tons capacity; draught, 17 feet. Kanawha, 800 tons capacity; draught, 16½ feet. Also other large steamers.

KINDS OF MECHANDISE RECEIVED BY SAIL VESSELS AND BARGES, NUMBER OF CARGOES OF EACH KIND, AND QUANTITY.

	Tons.
Domestic lumber, all kinds, one hundred and seventy-six cargoes	38,153
Foreign lumber, all kinds, one hundred and twenty-two cargoes	11,096
Coal received at this port	829,613
Coal arriving at this port, and thence by tow to Pawtucket	65,000
Brick, one hundred and twenty-six cargoes	14,555
Brick, for Pawtucket, arriving at this port first	2,500
Cement and lime, ninety-four cargoes, 93,213 barrels	12,484
Cement and lime, for Pawtucket as above, 3,300 barrels	442
Balance for Pawtucket shipped direct from this port.	
Pig-iron, one hundred and nineteen cargoes at this port	12,885
Pig-iron arrived for Pawtucket	1,200
Scrap-iron from home ports, sixty-one cargoes	7,245
Scrap-iron, foreign	3,474
Corn by sail vessels and barges, that arriving by steamers being accounted for in their aggregate, one hundred and sixty-four cargoes, 1,159,030 bushels	25,871
Oysters, one hundred and seventeen cargoes, 316,512 bushels	11,304
Molding sand, one hundred cargoes	13,605
Cotton, by sail vessels only, 21,865 bales	4,923
Salt, eighteen cargoes from home ports, 74,639 bushels	2,499
Salt, foreign, 92,104 bushels	3,083
Dye wood and chemicals from home ports, twenty-seven cargoes	2,991
Dye wood, foreign	1,760
Sulphur from home ports	373
Sulphur from foreign ports	1,244
Cotton-seed oil, four cargoes	2,682
Naptha, four cargoes	954

Asphalt from home ports				500
Potatoes	bushels	2,187	estimated	600
Oranges		19,000		
Bananas	bunches	4,679		
Coffee	pounds	2,450		
Cocoa-nuts		40,800		
Butter	pounds	60		
Molasses	gallons	100,032		
Total				1,071,036

GENERAL MERCHANDISE RECEIVED BY STEAMERS.

	Tons.
Baltimore line	52,694
Winsor's line	31,200
New York line	219,000
Continental line	10,950
Fall River line	18,250
William Marvel line	11,000
George W. Danielson line	2,500
Total, (2,240 pounds to the ton)	1,416,630

Tonnage of all vessels that arrived during the year that were reported,	1,866,528
Freight and cargoes of all kinds	1,416,630
Total	449,898

This difference is about what it should be, as most of the steamers did not near reach their tonnage capacity in amount of freight carried, while to all said vessels and barges about one-third should be added for actual carrying capacity, as for instance:

	Tons.
Steamer Massachusetts	2,606.83
Steamer Rhode Island	2,888.20
Steamer Galatea	1,566.70
Steamer Electra	1,566.70

Each of them arriving on an average ninety-one times a year—

Bringing	tons	219,000
Carrying	do.	219,000
Total	do.	438,000

Or 600 tons a day each way (2,240 pounds to the ton); while in case of barge Delaware, arriving February 1, 1882, with a cargo of 547 tons of coal, register tonnage 290.45, we have more than a half to add. Also schooner Charles A. Briggs, arrived February 25, 1882, with a cargo of 1,066 tons, register tonnage 757.93, here is one-third to add.

With this in view, probably this estimate will be found correct, or very nearly so.

Amount of merchandise shipped from this port, consisting of cotton and woolen goods of all kinds, machinery, stoves, furnaces, foundry-facings, sewing-machines, files, screws and other manufactures of iron, oils, chemicals, leather, baking-powders, yeast-powders, stove polish, rags, &c.

Brick, lime, cement:	Tons.
Baltimore line	19,174
Winsor's line	31,200
New York line	109,500
Continental line	10,950
Fall River line	18,250
William Marvel line	11,000
George W. Danielson	2,500
Total	202,574

By sail vessel and barge:	
Cotton waste	80
Iron	1,000
Salt, 1,050 tons; barrels, 500 tons	1,550
Oyster-shells, 4,464 tons; wadding, 6 tons	4,470
Lime, cement, pig-iron, coal, brick and lumber arriving at this port, for Pawtucket, also same shipped direct from here, estimated	104,000
Total	313,674

About 1,000 tons a day for 313 days; nothing leaving here for Pawtucket Sunday; 2,240 pounds to the ton.

RECAPITULATION, WITH ADDITIONAL STATEMENTS FOR THE YEAR 1882.

Number of vessels arrived according to marine reports:	
Coastwise	5,034
Foreign	164
Steamers in tow of barges, and not in marine reports	277
	5,475
Also vesssels over 5 tons and under 20 tons	

	Tons.
Tonnage of reported arrivals as per list of merchant vessels	1,866,528
Tonnage of steamers in tow of barges, and not in the marine reports	29,916
Tonnage of vessels under 20 tons	
Total	1,896,444

Merchandise received	1,416,630
Add wire for American Screw Company	1,500
Iron water-pipe for city	419
Total	1,418,549

Tons of 2,240 pounds to the ton.

The product of several large brick kilns, amounting to thousands of tons, and owned by parties doing business here, that are carried by scows to this city, Pawtucket, and other places on the river and bay, I have made no estimate of.

Steamer Nyanza, from London, arrived at this port December 18, 1882; draught 21½ feet.

Number of passengers on steamers, 519,118.

Improvement of Newport Harbor, Rhode Island.

At the date of the last annual report dredging under the appropriation of $25,000 by act of Congress approved March 3, 1881, was in progress. Mr. Edgar M. Payn, the contractor, completed his contract October 24, 1882, having removed 56,860 cubic yards in addition to the quantity reported in the last annual report as removed in the preceding fiscal year. The entire improvement under the Payn contract was in that part of the harbor which lies between Long Wharf and Commercial Wharf.

By act of Congress of August 2, 1882, $20,000 was appropriated for this harbor, and Maj. J. W. Barlow, in temporary charge after the death of General Warren (August 8, 1882), advertised on the 26th of September, 1882, for proposals for dredging to 18 feet at mean low water; two-thirds of the total quantity to be removed from the area between the harbor line, the curve of 18 feet depth, Long Wharf and Lime Rock, and the remaining one-third to be taken from the spit at the south end of Goat Island. The following proposals were received, and were opened October 20, 1882:

Names and addresses of bidders.	Price.	Date of commencement.	Date of completion.
	Per cu. yd.		
J. H. Fenner, Jersey City, N. J.	$ 24⅛	Nov. 10, 1882	June 30, 1883
James Caler & Son, Norfolk, Va.	24⅛	Mar. 5, 1883	Sept. 1, 1883
W. H. Beard, Brooklyn, N. Y.	26⅛	Nov. 10, 1882	June 30, 1883
Elijah Brainard, New York, N. Y.	27	July 1, 1883	Dec. 1, 1883
S. A. Hammond, Providence, R. I.	34¾	Nov. 10, 1882	June 30, 1883
E. H. Payn, Albany, N. Y.	34¾	Nov. 10, 1882	June 30, 1883

The lowest price (24⅛ cents) being named by two of the bidders, Mr. J. H. Fenner and James Caler & Son, the contract, with the approval of the Chief of Engineers, was awarded to the former, who proposed to commence and finish the work sooner than the latter; date of contract October 30. 1882.

On the 24th of November, 1882, the work, by direction of the Chief of Engineers, was transferred to Lieut. Col. George H. Elliot, Corps of Engineers. Mr. Fenner had commenced work under the above contract November 13, 1882, and the work of dredging in the inner harbor, as limited by the contract, was completed April 24, 1883. The dredging machine was then removed to the spit south of Goat Island, and work there was continued until June 20, 1883, when the contract was completed. The total quantity of material excavated during the last fiscal year under this contract was 73,585 yards.

The anchorage capacity of the inner harbor has been increased during the year about ten acres; and the entrance way between Lime Rock and Goat Island, with a minimum depth of 13 feet at mean low-water, has been increased 250 feet in width, which required dredging over an area 4.6 acres.

The estimated cost of the project under which the improvement of Newport Harbor is carried on was $132,000. This should be increased by the amount of $6,000 required for additional jetties on the west side of Goat Island, to arrest the drift of gravel and sand into the south entrance to the harbor.

There has been appropriated $45,000, leaving to be provided $93,000. This harbor is sheltered from every wind. It is much used by coasters and fishing vessels as a harbor of refuge, and in summer it is a favorite rendezvous for yachts. In the fishing season it is not unusual to see from one hundred and fifty to two hundred sail at anchor here in the approach of a storm. It is also prospectively of great importance as a military and naval station in the event of foreign war.

During the fiscal year, until the 6th of Jnne, 1883, this work was under the immediate supervision of Assistant Engineer H. A. Bentley, and since that date, of Assistant Engineer J. P. Cotton.

Newport is in the collectiou district of Newport, and is a port of entry. The amount of revenue collected in the last fiscal year was $3,133.71. The nearest light-houses are Lime Rock and Newport (Goat Island) lights.

The nearest fortification is Fort Adams, Newport, R. I.

Money Statement.

July 1, 1882, amount available		$8,041 05
Amount appropriated by act passed August 2, 1882		20,000 00
		28,041 05
July 1, 1883, amount expended during fiscal year, exclusive of outstanding liabililies, July 1, 1882	$23,552 24	
July 1, 1883, outstanding liabilities	4,130 04	27,682 28
July 1, 1883, amount available		358 77
Amount (estimated) required for the completion of existing project		87,000 00
Amount (estimated) required for additional work		6,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1885		50,000 00

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, NEWPORT, R. I.,
Collector's Office, July 26, 1883.

SIR: I have to acknowledge the receipt of your letters of May 22 and July 19, 1883. I am unable to furnish you statements in detail of the staple articles referred to that have been received in this district, as only vessels from a foreign port or those having dutiable cargoes make any report at this office.

During the year ending June 30, 1883, some five thousand vessels of all classes have come into this port either for a harbor or to discharge their cargoes. This includes steam and sail vessels, and those engaged in the coasting trade or fisheries, and yachts. The average draught of water of the coasting vessels is 9 feet.

During the year ending June 30, 1883, seven vessels entered this port from foreign ports, and discharged their cargoes here. Nine vessels cleared from this port for foreign ports, two of them carrying full cargoes.

The cargoes from foreign ports consisted of 168,415 feet spruce board, dutiable; 334,185 feet spruce board, produce of State of Maine; 189,000 feet hemlock board, produce of State of Maine; 650,700 feet spruce laths, produce of State of Maine.

The cargoes shipped from this port for foreign ports consisted of 585 tons fish guano, valued at $15,515; 1,121 bundles wood hoops, valued at $819.35.

During the year ending June 30, 1863, there has been say, 35,000 tons of coal discharged at the wharves of this port. There has also been received at this port, say, 3,000,000 shingles, 2,000,000 laths, 7,000,000 feet of lumber, 7,000 barrels lime, 3,000 barrels cement, and 2,500,000 brick.

The amount of revenue collected in this district for the year ending June 30, 1883, is as follows:

Duties on imports	$590 81
Marine-hospital tax	871 83
Inspection of steam vessels	543 70
Miscellaneous customs receipts	1,127 37
Total	3,133 71

There are one hundred and twenty-three vessels licensed and enrolled in this district, twelve steam and one hundred and eleven sail, the gross tonnage of which is 4,677.96 tons. The tonnage of the largest vessel is 367.03. The tonnage of the smallest vessel is 5.09. The largest vessel draws 13 feet of water when loaded.

These are all the statistics that occur to me. Should you require others, will try and obtain them.

Respectfully,

J. H. COZZENS,
Collector.

Lieut. Col. G. H. ELLIOT,
Engineer Office, U. S. A.

LETTER OF THE OLD COLONY STEAMBOAT COMPANY.

Old Colony Steamboat Company,
Newport, R. I., August 20, 1883.

Sir: I am in receipt of your letter of the 14th July, 1883, citing certain requirements of the Secretary of War relative to commerce and navigation, and asking me to furnish you with the aggregate amount of freight and passengers to, from, and through this harbor (Newport) by the steamers of the Old Colony Steamboat Company during the year 1882, and also such information as I may have respecting present condition of the harbor.

I respectfully submit the amount of freight carried by the steamers of this line to, from, and through this harbor during the year to be 241,750 tons, and the number of passengers to be 261,237.

I would respectfully represent that, inasmuch as the steamers of this line have been frequently detained in the channel between Lime Rock and Goat Island at low tide, drawing 13 feet of water, that an additional 2 feet or a total depth of 15 feet is necessary at all times to meet the requirements of the draught of water of the steamers of this line.

The depth of water in channel, as indicated on chart at mean low-water, is 13 feet. But inasmuch as there are times, particularly in stormy weather, that there would be, instead of 13 feet as marked on the chart, but 12 feet of water, scant, in midchannel, I would suggest dredging the channel until a depth of 15 feet is obtained below your present low-water mark. This would insure plenty of water at all times of tides for vessels drawing 13 feet to pass through. Any of the steamers of this line with an ordinary load will ground in present channel at extreme low-water.

George Peirce,
Supervisor of Old Colony Steamboat Company.

Geo. H. Elliot,
Lieut. Col. of Engineers, U. S. A.

Improvement of Block Island Harbor, Rhode Island.

At the date of the last annual report no work was in progress.

By act of Congress of August 2, 1882, there was appropriated $19,000 for this work.

After the death of General Warren (August 8, 1882) the work was temporarily in charge of Maj. J. W. Barlow, Corps of Engineers, until the 24th of November, 1882, when, by direction of the Secretary of War, it was transferred to Lieut. Col. George H. Elliot, Corps of Engineers.

A project for the expenditure of the appropriation, was submitted January 16, 1883. This project contemplated the erection of a harbor wall on the east side of the Inner Harbor, to serve in lieu of the crib-work filled with stone which has heretofore protected the Inner Harbor on that side, but which was intended only as a temporary structure, and the building of a jetty to protect the harbor from the material which was washed through the breakwater from the undermining of the cliffs to the southward and eastward. This was proposed to be done by the alternative plans of building a long jetty of riprap out to Lantern Rock and a shorter jetty of the same material running out from the shore under the cliffs. The latter plan was approved by the Chief of Engineers, and on the 14th of February, 1883, advertisements were issued inviting proposals. The following bids were received and were opened on the 17th of March, 1883:

Names and addresses of bidders.	Price per ton for riprap granite.	Price per cubic yard of wall.	Price per pile for foundation.
Charles H. Edwards, Boston, Mass.	$1 89	$17 89	$14 00
James Scully, Groton, Conn.	2 20	13 60	8 00
F. K. Ballou, Mystic Bridge, Conn.	2 19	18 55	14 88
John Beattie, Leete's Island, Conn.	2 50	20 75	21 00
Thomas A. Rowe and Robert G. Sylvester, Boston, Mass.	2 97	16 50	10 00
Edward S. Paine, Block Island, R. I.	2 09	....	....
Hiram A. Ball, Block Island, R. I	2 23	....	....
Charles T. Dery and James Burr, Boston, Mass	....	16 29	10 00
Hiram W. Phillips, Quincy, Mass.	....	18 90	16 80

With the approval of the Chief of Engineers the contract for furnishing the riprap granite for the jetty was awarded to Mr. Charles H. Edwards, the lowest bidder for the riprap granite, and the contract for building the harbor wall was awarded to James Scully, the lowest bidder for the wall.

Contractors and place of business.	Date of contract.	Subject of contract.	Price.	Date of commencement.	Date of completion.
Charles H. Edwards, Boston, Mass.	Mar. 26, 1883	Furnishing riprap granite for jetty.	$1.89 per ton of of 2,240 pounds of riprap.	Apr. 10, 1883	June 30, 1883
James Scully, Groton, Conn.	Mar. 26, 1883	Building harbor wall.	$13.60 per cubic yard of wall; $8 per pile for foundation.	Apr. 10. 1883	Aug. 15, 1883.

The building of the jetty, by authority of the Chief of Engineers, has been done by hired labor. The granite riprap was furnished by the contractor by means of splitting up the large bowlders which are found on Block Island.

The jetty, which is to be about 150 feet in length, with a head or T 100 feet in length, is still in progress.

The harbor wall is of granite in courses. It is 287 feet long, 8 feet wide at the bottom, for about 187 feet from the outer end, and 6 feet wide at the bottom for the remainder. It is 8½ feet high and 6 feet wide at the top throughout. It is partly founded on piles, sawed off below low water, and partly on a riprap foundation. The progress made by the contractor for the harbor wall is not altogether satisfactory, but it is hoped the contract will be completed in the time agreed on. Some minor repairs to the Government wharf on the south side of the inner habor have been made, and the wharf on the west side, which had become so much decayed as to be dangerous, has been torn down.

The timber crib-work which protects the inner harbor on the west and north sides should also be replaced by walls of stone, as they are much decayed and liable to destruction in heavy storms. The south wharf (of wood), at which the freight shipped to and from the island, the United States mails, and the supplies for the light-houses on the island are landed, should be replaced by a retaining wall with earthern filling behind it. The estimated cost of these works is $30,000.

The further sum of $35,000 could be advantageously expended in the next fiscal year in the extension of the breakwater to secure additional shelter, and in that way relieve the inner harbor, which at times is too small to hold the vessels which seek it for refuge.

During the fiscal year this improvement has been under the immediate supervision of Assistant Engineer J. P. Cotton.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge for coasting vessels. There are three light-houses on the island, the North and South lights and the Breakwater light. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1882, amount available		$65 14
Amount appropriated by act passed August 2, 1882		19,000 00
		19,065 14
July 1, 1883, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1882	$3,244 85	
July 1, 1883, outstanding liabilities	1,716 62	
		4,961 47
July 1, 1883, amount available		14,103 67
Amount (estimated) required for additional work		65,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1885		65,000 00

COMMERCIAL STATISTICS.

BLOCK ISLAND, R. I., June 11, 1883.

DEAR SIR: In compliance with your request by letter under date of the 22d ultimo, I send you herewith such facts in relation to the same as I am able to produce, hoping they may be of value to you.

Coal	tons..	2,500
Iron	do...	75
Grain	bushels..	60,000
Lumber	feet..	2,000,000
General merchandise shipped and received	tons..	150,000

Arrival and departure of steam vessel, 1,200, varying from 50 to 1,000 tons and drawing from 3 to 10 feet.

* * * * * * * *

I am yours very truly,

NICHOLAS BALL.

GEO. H. ELLIOT, Esq.

Improvement of Little Narragansett Bay, Rhode Island and Connecticut.

At the date of the last annual report no work was in progress.

By the act of Congress of August 2, 1882, $6,000 was appropriated for this improvement, and Maj. J. W. Barlow, Corps of Engineers, in temporary charge after the death of General Warren (August 8, 1882), advertised on the 16th of September, 1882, for proposals for widening the channel made by former appropriations, from Pawcatuck Point to the deep water, to the west, making a depth of 7½ feet at mean low-water.

The following proposals were received and were opened October 10, 1882:

Names and addresses of bidders.	Price.	Date of completion.
	Per cu. yd.	
Hartford Dredging Company, Hartford, Conn	$0 20 9-10	June 30, 1883
J. H. Fenner, Jersey City, N. J	29⅞	June 30, 1883

The contract with the approval of the Chief of Engineers, was awarded to the Hartford Dredging Company, the lowest bidder; date of contract October 30, 1882.

On the 24th of November, 1882, the work, by direction of the Secretary of War, was transferred to Lieut. Col. George H. Elliot, Corps of Engineers.

Dredging under the above contract had been commenced November 17, 1882, and it was continued until December, 1, 1882, when the tug-boat was frozen in and the work was suspended for the winter. It was resumed April 7, 1883, and was prosecuted to May 26, 1883, 20,867 cubic yards having been removed, completing the original project for a channel through the bay 200 feet wide, except for a short distance opposite Pawcatuck Point, where some rocky material, not included in the contract was encountered. This was subsequently removed by days' work.

There is remaining a considerable number of bowlders of various sizes in the bottom and on the sides of the dredged channel, and also in the channel at Watch Hill Landing, which will be removed later in the season, as soon as it can be done without interferring with the summer use of the channel by steamers. This work will be executed with the remainder of the appropriation, and will complete the improvement of Little Narragansett Bay as far as projected. The completed channel, for which good ranges on shore should be provided, will enable steamboats and vessels drawing from 9 to 10 feet, bound for Pawcatuck River and Westerly and also to Watch Hill, to cross the bay at any stage of the tide, and they can now take advantage of the improvement made by the general government in the Pawcatuck River.

Up to the 6th of June, 1883, this work was under the immediate supervision of Assistant Engineer H. A. Bentley.

Little Narragansett Bay is in the collection district of Providence and Stonington, the dividing line passing through the bay. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $286,443.90; Stonington $2,328.31. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1882, amount available		$277 88
Amount appropriated by act passed August 2, 1882		6,000 00
		6,277 88
July 1, 1883, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1882	$4,942 84	
July 1, 1883, outstanding liabilities	199 20	
		5,142 04
July 1, 1883, amount available		1,135 84

COMMERCIAL STATISTICS.

LETTER OF MESSRS. RANDOLPH BENTLEY & CO.

WESTERLY, R. I., June 5, 1883.

DEAR SIR: In compliance with the request in your inclosure of 22d ultimo, we have collected from what we consider authentic sources the following statistics in relation to commerce on Pawcatuck River and Little Narragansett Bay during the year 1882.

Coal brought to Westerly	tons..	17,729
Iron brought to Westerly	do...	820
Grain brought to Westerly	bushels..	47,800
Lumber brought to Westerly	feet..	4,150,000
Moulding sand brought to Westerly	tons..	282
Brick brought to Westerly		538.000
Stone shipped from Westerly	tons..	6,010
Steam barges arrived at Westerly		10
Vessels towed to Westerly		217
Vessels discharged at Stonington and cargoes brought on lighters to Westerly		89

Character of vessels, mostly schooners; tonnage of vessels, 150 to 200; draught of vessels, average 7 feet.

One steamboat made four daily trips between Westerly and Watch Hill during summer season. One small steamer made several daily trips between Watch Hill and Stonington during the summer season.

Passengers carried on Pawcatuck River about 40,000; on Narragansett Bay, unknown, but estimated as about 30,000.

Any further information which you may suggest we shall be happy to obtain if possible.

We have the honor to remain, yours most respectfully,

RANDOLPH BENTLEY & CO.

Lieut. Col. GEORGE H. ELLIOT,
Corps of Engineers U. S. A.

LETTER OF MESSRS. MAXSON & CO.

WESTERLY, R. I., June 10, 1883.

SIR: In reply to your communication of May 22, we beg to state that we have given the matter contained therein as much attention and thorough investigation as our limited time would allow, as we are very busy indeed just at this season. We have been informed from other sources that Messrs. Randolph, Bentley & Co. and G. B. & J. H. Utter were also looking up the same thing, but not wishing to interfere in any way with what you may have received from them, we take pleasure in remitting such facts as we have been able to collect. We have visited some of the mills, quarries, grain and coal dealers, foundries, &c., for facts. We present some facts given by the captain of our tug-boat (Capt. William Greenman), which facts we presume also Messrs. Randolph, Bentley & Co. have or will give you, viz: There have been received in 1882 up our river 15,619 tons of coal by sailing vessels, 2,210 tons by steam vessels; total, 17,829 tons; 4,372,720 feet of lumber, *all* discharged at Stonington and lightered up our river; 415,000 bricks; 23,900 bags (2 bushels each) of grain; 820 tons iron; about 400 tons sand; 6,010 tons stone sent out of river.

There have been towed up and down our river two hundred and fourteen loaded vessels, besides numerous lighters and smaller craft which sailed. There have been discharged in Stonington thirty-five vessels, being unable to get up here on account of insufficient depth of water. The above all came by water.

We append below a very few facts in relation to what came by cars which would have come by water had we 9 or 10 feet of water, viz: About 1,200 tons of cotton, 2,000 tons of coal, and 3,000 tons of wool, lime, lumber, cement, grain, &c.

We tried to ascertain the amount of business done by the principal business firms here, but find them mostly unwilling to give statistics in relation thereto, but we can figure it up easily to quite a number of millions dollars.

Many mills, quarries, &c., ship by railroad, because they cannot do otherwise. Several years ago the business men of Westerly met for the purpose of establishing a freight line between Westerly and New York, if it seemed practicable, which project was finally discarded, because of insufficient depth of water. We are laboring under a great disadvantage here by reason of having no competing line. The Stonington Steamship Company and our railroad charge us just what they please and we cannot help ourselves. We have to pay more by 30 to 50 per cent. from New York to Westerly than the rate from New York to Boston. Boston rate, 18 cents; Westerly, 25 cents. The receipts at our depot are about $1,000 per week.

All lumber for Westerly has to be handled over in Stonington, thus injuring it very much, aside from the extra expense of transportation or lightering. The same to some extent with coal, but not so much. We find it extremely difficult—almost impossible—to charter light-draught vessels for lumber to come over the shoals, hence our great expense in lightering lumber.

We wish you could make it convenient to come here and look the ground over, as we believe you would find it a field worthy of an outlay. The question of deeper water here is one of vital importance to the business interests of Westerly, and could you make it convenient to come here we should take pleasure in showing you over the ground.

Trusting that these few facts, though incomplete, may be of service to you,

We are, very respectfully, yours,

MAXSON & CO.

GEO. H. ELLIOT,
Lieut. Col. of Engineers.

N. B.—We failed to mention the fact that between 40,000 and 50,000 passengers were carried on our short river last year. Much of the commerce credited to Stonington really belongs to Westerly, as we cannot get nearer with large vessels.

Eng 1010.37

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, A. D. 1885.

PROVIDENCE:
E. L. FREEMAN & CO., STATE PRINTERS.
1885.

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

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The Commissioners.

HARBOR COMMISSIONERS' REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Ninth Annual Report:

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed Lucius B. Darling, of Pawtucket, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

HARBOR LINES.

A harbor line in Wickford harbor, from Quonset Point to Bissell's Cove, was designed by the Commissioners, after careful surveys had been made and several duly advertised public hoarings held. This line was reported to the General Assembly at the January Session of 1884, and an Act establishing the line, accordingly, was passed by the Senate, but final action upon the matter was not taken by the House. Petitions have been presented to the Commissioners for authority to build and change certain wharves in the harbor, and it seems desirable that definite action in reference to the harbor line be taken at an early day.

A communication has been addressed to the General Assembly, suggesting that an amendment be passed to the "Act to establish a harbor line in the harbor in the city of Providence, between Fox Point and the railroad bridge at India Point," defining the location of the point designated by letter G, in said act, to be on the party line between land formerly of the Providence Iron Company and land of James T. Rhodes and heirs of Peleg A. Rhodes, at a distance of 212 feet from India street.

ENCROACHMENTS AND DUMPING.

Constant care is still required to prevent encroachments, obstructions and unauthorized dumping in public waters.

Efforts, in addition to those of the Commissioners personally, have been made to check encroachments, by warning advertisements inserted in newspapers and by printed circulars sent through the mail to all persons known to be interested, and by inspectors occasionally engaged.

On June 25, 1884, the following resolution was passed:

> "*Resolved:* That a common dumping ground is hereby designated as follows: in water, not less than ten fathoms deep at mean low water, south of an east and west line touching the southern extremity of Prudence Island and north of an east and west line touching the northern extremity of Gould Island. All permits for dumping elsewhere are hereby revoked."

Dumping ashes from steamers has been a cause for complaint, and special measures against this injurious practice have been and will be taken. Offenders are liable to a fine of one hundred dollars for each offence, one-half to the use of the complainant.

The plans for Washington Bridge having been fully determined upon, and the foundations largely completed, the Commissioners have notified the city of Providence to report the amount of material displaced by the construction of an embankment on the "Brook Street District," as defined in a contract made by the city with the Harbor Commissioners, dated March 2, 1878, with a view of requiring certain dredging to be done by the city in compensation for such displacement.

LICENSES, ETC.

Licenses have been issued as follows:

No. 47. January 9, to the Lonsdale Company, for rebuilding a portion of their wharf occupied by the Providence, Norfolk and Baltimore Steamship Company, near India street, in Providence.

No. 48. April 3, to Charles S. Horton, for the construction of a stone wharf from the west shore of Pawtuxet Neck, in Pawtuxet Cove, in Cranston.

No. 49. April 23, to Moncrief & McLay and Lyman B. Goff, for the construction of a bridge wharf in Pawtucket river, on the west side, and south of Division street, in Pawtucket.

No. 50. August 27, to Horace G. Miller, to build a sea wall at Pawtuxet Neck, in Cranston.

No. 51. August 27, to John W. Mitchell, to build a sea wall at Pawtuxet Neck, in Cranston.

No. 52. October 8, to James H. Field, to build a stone pier, in Pawtuxet Cove, in Cranston.

No. 53. October 22, to the Town of Pawtucket, to build a wall across the slip at the north end of the Town landing, on the west side of Pawtucket river, in Pawtucket.

No. 54. October 22, to A. Hart, for building an extension to his wharf, in Pawtuxet Cove, in Cranston.

No. 55. December 4, to the Heirs of Joseph Tillinghast, and John Waterman, Attorney, to rebuild and extend their wharf near South Water street, in Providence.

No. 56. December. 17, to the Providence Institution for Savings, for rebuilding their wharf, known as the wharf of the Tingley Marble Company, near South Water street, in Providence.

Assent has been given as follows:

1. February 27, to Edward S. Babbitt, for building a retaining wall in front of his estate on Thames street, between the wharves of the National Rubber Company and the Fall River Steamboat Company, in Bristol.

2. April 3, to Smith Shaw, for constructing a bridge wharf from the shore at Cedar Grove, in East Providence.

3. December 31, to Verrano V. Chase, for strengthening and protecting the wharf at Sabin's Point, in East Providence.

BOUNDARY LINE.

The Act to define the Boundary Line of tide water between the State of Rhode Island and Providence Plantations and the State of Massachusetts, passed April 25, 1884, completed the necessary legislation for that purpose, a similar act having been previously passed by the Legislature of Massachusetts.

MISCELLANEOUS.

There is an increasing necessity for the supervision exercised by the Harbor Commissioners, as to the manner in which the shores are occupied and the public waters are used by private persons. Many matters have occupied the attention of the Commissioners, which in items seem not of sufficient importance to report upon, but which in the aggregate, if unattended to, would greatly affect the usefulness of the tide waters to the public. Of matters which have required special attention in this way, may be mentioned dumping ashes, etc., from shores, scows and steamboats; maps and surveys; marine railway; several insecure wharves in various places; proposed constructions desired or opposed, about which there are questions as to jurisdiction; obstructions to channels by wrecks, etc.; constructions where the authority given by the General Assembly may have been exceeded, etc., etc.

ADVISORY COUNCIL.

By special order of the War Department, issued February 27, 1884, an appointment to the Advisory Council was made as follows:

"3. By direction of the President, Lieutenant-Colonel *George H. Elliot*, Corps of Engineers, is designated as a member of the Advisory Council, appointed by the President, in January, 1877, to the Rhode Island State Board of Harbor Commissioners, *vice* Lieutenant-Colonel *G. K. Warren*, Corps of Engineers, deceased."

The Board is now composed as follows: Of Rear Admiral Daniel Ammen, U. S. N.; Professor Henry Mitchell, U. S. C. & G. S.; and Lieutenant-Colonel George H. Elliott, U. S. A.

WORK UNDER U. S. ENGINEER.

Active operations have been resumed in improvements by the General Government. Dredging was commenced October 23d on the 25 feet channel between Field's Point and Pomham Light, under a contract with the Atlantic Dredging Company. The work on this reach is now about half completed. Forty-nine bowlders have been removed from the mouth of Pawtuxet river, leaving a clear channel four feet deep at mean low water, and about sixty feet wide at the narrowest place. Dredging was commenced in Newport harbor on the seventeenth of October, under a contract with the Hartford Dredging Company. A channel ten feet deep at mean low water and sixty feet wide has been dredged for a distance of about eleven hundred feet southerly, along the harbor line in the south part of the harbor. Dredging is now in progress on the east side of the main channel running northerly through the harbor. By the work done to date, this harbor has been much improved.

By the courtesy of Col. Elliot, we have been furnished with a report of the work done in Rhode Island waters since June 30, 1884, which will be found in the Appendix, together with extracts from the report of Col. Elliot to the Chief of Engineers, U. S. A., in relation to the work under his charge previous to July, 1884.

Respectfully submitted,

J. HERBERT SHEDD,
LUCIUS B. DARLING,
HENRY C. BRADFORD,
Harbor Commissioners.

APPENDIX.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 27, 1884.

J. HERBERT SHEDD, Esq.,
Chairman of Harbor Commissioners, Providence, R. I.

SIR: I take pleasure in complying with your request of the 22d inst. for a résumé of my works in Rhode Island since the date of my last annual report to the Chief of Engineers.

The works in progress in this State during this period are as follows:

Providence River and Narragansett Bay.
Pawtuxet River.
Newport Harbor.

1st. *Providence River and Narragansett Bay.*

The report just mentioned brought the work down to July 1st, 1884. At that date no dredging was in progress, the contract under which dredging was carried on during the fiscal year ending June 30, 1884, having been completed in November, 1883.

By authority of Act of Congress of July 5, 1884, a contract was made with the Atlantic Dredging Company, and work was commenced Oct. 23 on the excavation of the channel 25 feet deep at mean low water and 300 feet wide between Field's Point and Pomham Light, which we denominate the Pomham Reach.

Two dredges are now at work on this channel, which is now about half completed.

From the above and from the report above referred to, of which I had the honor to send you a printed copy, you will observe that the upper three of the straight reaches into which I have divided the new 25 foot channel, viz.: the Fox Point, the Sassafras Point and the Field's Point reaches, have been excavated to the full width of 300 feet. Of the three lower reaches, the Pomham is now excavated to a width of not less than 230 feet, while the Pawtuxet and Gaspee reaches have not less than 200 feet of the projected width of 300 feet.

2d. *Pawtuxet River.*

In the Act of Congress of July 5, 1884, making appropriations for Providence River and Narragansett Bay, an item of $1,000 was included for removing bowlders at the mouth of the Pawtuxet River.

The expenditure of the amount available was limited to removal of the most dangerous obstructions, and work was commenced on these by hired labor on Sept. 1st and finished Sept. 26, 1884. Forty-nine bowlders were removed, leaving a clear channel four feet deep at mean low water, and about 60 feet wide at the narrowest place.

3d. *Newport Harbor.*

Dredging was commenced in this harbor Oct. 17th under a contract made with the Hartford Dredging Company, and is now in progress A channel 10 feet deep at mean low water and 60 feet wide has been dredged for a distance of about 1,100 feet southerly, along the harbor line in the south part of the harbor. This channel was finished Nov. 17. On that date dredging was commenced on the east side of the main channel running northerly through the harbor, and is now in progress. By the work done in this locality up to date, the main channel at the bend northeast of Lime Rock Light and opposite the pile beacon at the southeast extremity of Goat Island, has been widened 120 feet for a distance of 800 feet, giving a clear channel of 15 feet depth at mean low water.

Two bowlders were removed from the harbor in the latter part of September, 1884, by hired labor.

Very respectfully,

GEORGE H. ELLIOT,

Lieut.-Col. of Engineers.

EXTRACT FROM REPORT OF LIEUT.-COL. ELLIOT TO CHIEF OF ENGINEERS, U. S. A., FOR 1884.

Improvement of Pawtucket River, Rhode Island.

By instructions from the Chief of Engineers, dated the 24th of April, 1883, I was directed to have made a survey of Pawtucket River, Rhode Island, in compliance with the river and harbor act of August 2, 1882, and to submit a report thereon and a project for the improvement of the river. The report and project, with a history of the improvement which was commenced in 1868, were submitted to the Chief of Engineers on the 8th of November, 1883, and are appended hereto. No other work was done during the fiscal year 1883-'84. A plat of the river showing the proposed channel accompanies this report.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

The rebuilding of Washington Bridge with good and sufficient draw-openings having been commenced, it is proposed with the appropriation made by the act of Congress of July 5, 1884, to commence the excavation of a channel extending from the deep water at Red Bridge to a point opposite Grant & Co.'s Wharf, at Pawtucket, 100 feet wide and 12 feet deep at mean low water, and carry it as far as the funds will pay for.

Pawtucket River is in the Providence collection district, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $202,227.57. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort at Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1883, amount available	$529 58
July 1, 1884, amount available	529 58
Amount appropriated by act approved July 5, 1884	50,000 00
Amount available for fiscal year ending June 30, 1885	50,529 58
Amount (estimated) required for completion of existing project	332,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1886	75,000 00

COMMERCIAL STATISTICS.

PAWTUCKET, R. I., June 29, 1884.

DEAR SIR: Your letter asking for information from the Business Men's Association was handed me a few days ago for reply.

I have examined into the statistics somewhat and find that the report of June 14, 1883, contains very nearly the statistics for a corresponding time of 1884. The coal tonnage is, however, increased about 7,000 tons, and I presume that there has been a gradual increased consumption of other materials of 5 to 8 per cent. over 1883.

Trusting that this is sufficient data for your report, I remain,

Very respectfully, yours,

GEO. E. NEWELL.

GEORGE H. ELLIOT,
Lieut.-Col. of Engineers.

PRELIMINARY EXAMINATION OF PAWTUCKET RIVER, RHODE ISLAND.

NEW LONDON, CONN., November 8, 1882.

This river was surveyed in 1870 and 1873, besides which partial examinations were made in 1872 in connection with improvements then in progress, and in 1879 very complete tidal observations were made, chiefly with the object of determining the influence of three bridges on the currents of the river. With the information obtainable from the maps and reports of these surveys and improvements, a preliminary examination of the locality seems unnecessary.

Since 1867 $52,000 has been appropriated for this improvement, making the depth of channel 7 feet at mean low water, where the available depth had been 4½ feet. The dredged channel is 75 feet wide. The mean rise of tide is about 5 feet.

The last appropriation made for the Pawtucket River was in 1873. Since its expenditure the business of Pawtucket has greatly increased, and there is a demand for a channel of greater depth and width.

It is to obtain a project with estimates for an enlarged channel that this survey is desired.

Pawtucket is a manufacturing place of about 30,000 population; the improvement desired would be of general benefit to the community, and is undoubtedly one worthy to be made, and the work a public necessity, if the cost be not unduly great. This latter can be satisfactorily determined only by survey.

In my judgment, the survey ought to be made, and I recommend an allotment of $500 from the general appropriation for surveys for this purpose. If the field-work is to be done this fall, the allotment should be made by telegraph.

Respectfully submitted,

J. W. BARLOW,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers.

SURVEY OF PAWTUCKET RIVER, RHODE ISLAND.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., November 8, 1883.

GENERAL: I have the honor to submit herewith a plat* of the survey of Pawtucket River, Rhode Island, and estimates of cost of its improvement which were authorized by the river and harbor act of Congress of August 2, 1882, and placed in my charge by your instructions of April 24, 1884.

DESCRIPTION OF THE RIVER.

Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a distance of about 4½ miles, and forms a tidal basin of about 1½ square miles. The mean rise and fall of the tide is about 5 feet. The continuation of the river above Pawtucket is called the Blackstone River, and is not navigable. At the mouth of the Pawtucket it is spanned by two bridges, parallel and about 250 feet apart. The upper, the old Washington Bridge, is a highway bridge, and the other is a railroad bridge belonging to the Boston and Providence Railroad Company. The draw of the Washington Bridge is close to the eastern shore, and is so narrow and illy located and constructed as to render navigation through it difficult and dangerous. By reason of this obstruction to the navigation of Pawtucket River, my predecessor, the late General Warren, declined for several years before his death, in August of last year, to estimate for further appropriations for its improvement; but the legislature of the State of Rhode Island, at its January session of last year, enacted a law by which a new draw-bridge is to be built on or near the site of the present bridge. This law requires that the bridge shall be completed within two years from the appointment of a board of commissioners; that it shall have a swing draw with two openings of not less than 80 feet wide each, and that the channel of the river under and around the present bridge shall be cleared of all obstructions to the tidal flow to a depth of 15 feet below mean low water.

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*Omitted.

The railroad bridge does not seriously obstruct the tidal flow on which the maintenance of the channel of the Pawtucket depends, but the draw of this bridge is also badly located, and is too narrow. The draw openings are only 60 feet wide, and fender piles reduce the available width to about 47 feet. It is probable that when Washington Bridge is rebuilt the navigation interest of the town of Pawtucket will demand and effect an amelioration of the draw of the railroad bridge.

About four-fifths of a mile above Washington Bridge is Red Bridge, with two draw openings of 80 feet wide each. These openings were dredged in 1875 to a depth of 12 feet at mean low water.

The natural channel of the Pawtucket before improvement had a ruling depth of about 5 feet at mean low water. From 1868 to 1875 this channel was dredged to a width of 75 feet, and to a ruling depth of 7 feet at mean low water, under several small appropriations, amounting in all to $52,000.

SURVEY OF 1883.

The recent survey was commenced in the latter part of August last by Mr. W. H. Lawton, Jr., assistant engineer, and a party in the United States schooner Surveyor. The entire river from Red Bridge to Pawtucket Bridge was first covered by a system of triangulation. In the subsequent sounding operations the location of each sounding was determined by two angles turned from the sides of the triangles which were used as bases.

After the completion of the soundings, the Surveyor was again sent to the river with a boring party under the charge of Mr. John S. Engs, Jr. Mr. Engs, with the assistance of Captain Case and the crew of the schooner, made a large number of borings in the bed of the river, the results of which will be found in tabular form on the plat of the survey. Each boring was located in the same manner as the soundings, and was driven to a depth of 12 feet below mean low water, except when stopped by ledge rock. In such cases, a few of which occurred in the upper part of the survey, the table of borings shows the depth to the ledge. In connection with the soundings, the borings enable us to form a very close estimate of the quantities of materials of various kinds necessary to be removed in the improvement of the river, and in case of further appropriations for the work, they will be of service to ourselves and to bidders in estimating the cost of dredging the sections into which the channel may be divided for contract.*

The river having been carefully surveyed in 1873 by Mr. H. A. Bentley, assistant engineer, under the direction of the late General Warren, I deemed it unnecessary to run the shore lines again, or to sound out the broad areas of shallow water which occupy a large portion of the river between Pawtucket and its mouth. The *shore lines* on the plat herewith, except above the Gas Company's Wharf, have, therefore, been taken from the plat of the former survey.

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* For a description of the apparatus used in making the borings, see Appendix.

CHANGES SINCE THE SURVEY OF 1873.

At Red Bridge the eastern passage of the draw, which was dredged to 12 feet at mean low water in 1873, has more than kept its depth. The least depth now existing in that passage is 18.7 feet at mean low water. In the western passage the depth remains practically the same as in 1873.

From Red Bridge northward, to opposite the north end of Sand Point, the channel remains practically in its position of 1873, and carries the same depth, except at the red buoy southwest of Narragansett Boat Club House, where a slight shoaling of about five-tenths of a foot has taken place for about 400 feet.

Opposite the north end of Sand Point the 9-foot contour in the channel has moved down stream about 300 feet. The 6-foot contours remain about the same as in 1873.

Between Sand Point and Swan Point Wharf the channel remains the same as in 1873, except that the 6-foot contours have moved slightly towards the right or west bank of the river, and a shoaling of from 1 to 2 feet for about 300 feet has occurred just north of Butler Asylum Wharf.

Shoaling has occurred in the channel off Swan Point Wharf. The portion of the channel southwest of Swan Point Wharf, which was dredged to 9 feet at mean low water in 1873, has now a maximum depth of 7 feet at mean low water. Off the northwest corner of Swan Point Wharf the channel, dredged to 9 feet at mean low water in 1873, has filled about 2 feet on the average.

From Bucklin's Island to the wharf of the Pawtucket Gas Company, there has been a general shoaling of the channel from 1 to 2 feet. The most marked change in this part of the channel is shown between Bishop's Point and Dunnell's Wharf, where the depths of water in the portions dredged in 1873 to 9 feet at mean low water now run from a least depth of 4½ feet to a greatest depth of 7½ feet at mean low water, although between 6 and 7 feet can still be carried through this part of the channel.

The most marked filling has taken place, for a short distance, opposite the north side of the Pawtucket Gas Company's Wharf. Here the channel has been crowded over close to the western bank by the shoal formed by deposits brought down by a sewer on the east bank of the river. In 1873 a cut was dredged to 7 feet at mean low water; this has been filled from 2 to 3 feet.

Dredging has been done from time to time, by private individuals, between the Gas Company's Wharf and Pawtucket Bridge, and no useful comparison can be made in this part of the river between the surveys of 1873 and 1883.

PRESENT CONDITION OF THE CHANNEL.

It will be observed from the above and from an inspection of the plat of the recent survey, that the deposits in the channel since 1878, or during an interval of ten years, are not excessive; that the channel which had been dredged from a ruling depth of 5 feet to one of 7 feet at mean low water has held its own as well as could be expected, and that a draught of from 6 to 7 feet can still be carried at mean low water from Pawtucket to the mouth of the river, although the channel is narrow and in some places tortuous.

MATERIAL OF THE BED OF THE CHANNEL TO A DEPTH OF 12 FEET BELOW MEAN LOW WATER.

The tabular statement found on the plat of the results of the borings in the bed of the channel shows that in going up river from the deep water near Red Bridge to Swan Point, a distance of about 6,500 feet, the material is almost entirely mud; from Swan Point to a point opposite Grant & Co.'s Wharf, at Pawtucket, a distance of about 9,000 feet, the material is mainly gravel and sand, interspersed in the upper part of this distance with stones; thence to Pawtucket Bridge, a distance of about 750 feet (from boring 82), we find ledge rock appearing at depths less than 12 feet at mean low water. Seal Rock, a part of this ledge, projects into the channel in front of Grant & Co.'s Wharf. The top of this rock is 2¼ feet above mean low water, and a large part of it must be removed in carrying out any scheme for the improvement of the upper part of the river.

THE REASONS FOR THE DEMAND FOR FURTHER IMPROVEMENT OF THE RIVER, AND THE AMOUNT OF COMMERCE INTERESTED.

The reasons for the demand for an increased width and depth of channel and the amount of commerce interested are fully set forth in the letters from the Business Men's Association of Pawtucket, which will be found appended to this report.

The statements contained in these letters are believed to be substantially correct.

ESTIMATES OF THE COST OF IMPROVEMENT.

It will be observed that the business men of Pawtucket desire a channel with a minimum width of 150 feet and 12 feet deep at mean low water, and I have prepared an estimate of the cost of such a channel extending from the deep water just above Red Bridge to a point in the natural channel where the ledge rock appears at depths less than 12 feet below mean low water. This, as before stated, is opposite Grant & Co.'s Wharf, and about 750 feet below the bridge at Pawtucket. From this point to the bridge I have estimated for a channel in rock cutting 40 feet wide and to a depth of 12 feet at mean low water.

The excavation, at the expense of General Government, of a *wide* channel through the rock which lies between the wharves on either side of the river is probably out of the question, on account of the expense, and, in my judgment, is not necessary, since the river here is very narrow. The proposed rock cutting is short, and there are on the east side, as will be observed on the plat, two natural side pockets or basins of 12 feet depth and more, one at the mouth of the proposed narrow channel and the other about midway to the bridge, where vessels can lie when waiting to pass or to get to their berths at the wharves. These waiting basins would, I think, be found quite sufficient in size, since vessels destined for Pawtucket, as a general rule, remain in Providence River until their berths at Pawtucket are ready for them.

The channel through the rock, of the dimensions above stated, being furnished at the expense of General Government, the remainder of the expense necessary for providing means to get deep-draught vessels to the wharves, namely, the berths at the wharves and communications from them to the channel, would doubtless be provided for by the wharf-owners.

The following is the estimate above referred to:

MAIN CHANNEL 12 FEET DEEP AT MEAN LOW WATER, AND 150 FEET WIDE FROM RED BRIDGE TO THE LEDGE OPPOSITE GRANT & CO.'S WHARF, THENCE TO PAWTUCKET BRIDGE 40 FEET WIDE.

Mud excavation, 246,667 cubic yards, at 35 cents	$86,333
Gravel and sand excavation, 388,000 cubic yards, at 50 cents	194,000
Rock excavation, 5,467 cubic yards, at $35	191,345
	$471,678

I have estimated the costs of channels of other widths and depths, the depth of rock cutting in each case being the depth of the main channel below, and they are as follows:

MAIN CHANNEL 100 FEET WIDE AND 12 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 148,000 cubic yards, at 35 cents	$51,800
Gravel and sand excavation, 278,667 cubic yards, at 50 cents	139,333
Rock excavation, 5,467 cubic yards, at $35	191,345
	$382,478

MAIN CHANNEL 150 FEET WIDE AND 10 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 150,667 cubic yards, at 35 cents	$52,733
Gravel and sand excavation, 266,667 cubic yards, at 50 cents	133,334
Rock excavation, 3,400 cubic yards, at $35	119,000
	$305,067

MAIN CHANNEL 100 FEET WIDE AND 10 FEET DEEP AT MEAN LOW WATER. ROCK CUTTING 40 FEET WIDE.

Mud excavation, 93,333 cubic yards, at 35 cents	$32,666
Gravel and sand excavation, 186,667 cubic yards, at 50 cents	93,334
Rock excavation, 3,400 cubic yards, at $35	119,000
	$245,000

A depth of 12 feet at mean low water (17 feet at mean high water) is doubtless required for the commerce of Pawtucket, and if we make a channel of this depth, it would probably be sufficient for many years to come. I am inclined to doubt, however, the necessity for making the width of channel as great as 150 feet, since the freights between the port of Providence and Pawtucket are almost exclusively propelled by steam. If the width in the first instance be made 100 feet; if we cut off the angles so as to widen the channel at these points, and place good range beacons on the shores of the river for marking the axes of the different reaches of the channel, I think it will be sufficient for the present.

My judgment is, therefore, that the "improvement proper to be made" in this case is a channel 12 feet deep at mean low water, 100 feet wide from Red Bridge to the ledge opposite Grant & Co.'s Wharf, thence 40 feet wide to Pawtucket Bridge.

The estimate of the cost of this improvement is $382,478.

In view of the serious obstruction to the navigation of Pawtucket River by the present Washington Bridge, and of the delay in the appointment of two of the commissioners, under the recent act of the legislature of Rhode Island, which provides for the rebuilding of this bridge, with proper draw-openings and the removal of stone and other materials which have been deposited under and above it, it is recommended that the first appropriation for the work be accompanied by the following proviso:

> Provided that this appropriation shall not become available until the officer in charge shall have reported that the rebuilding of Washington Bridge, with good and sufficient draw-openings, has been commenced.

It should be remarked, in conclusion, that in estimating the cost of the work allowance has been made for the difficulty of getting tows of scows containing the excavated material through the bridges near the mouth of the river, and for the long distance which they must be taken for dumping. The soft material should not in any case be dumped where it will be carried back into the channels to be excavated in this river and now excavated in Providence River. Possibly it may be safe to dump the gravel in the shoal places of Pawtucket River, but probably the whole of the excavated material will have to be towed to the dumping ground below Prudence Island, in Narragansett Bay, in the vicinity of Half Way Rock, which is now used in the improvement of Providence River, an average distance of about 22 miles.

Respectfully submitted,

GEORGE H. ELLIOT,
Lieut. Col. of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

AN ACT providing for clearing the channel of the Seekonk River at India Point, in Providence, of obstructions, and for the construction of a bridge near the site of the Providence Washington Bridge.

It is enacted by the General Assembly as follows:

SECTION 1. The city of Providence may elect, on or before the 1st day of July, A. D. 1883, to remove forthwith the stone and other materials deposited in the Seekonk River, under and near Washington Bridge, so called, at India Point, in said city, from said river, and cause the channel thereof under and around said bridge to be dredged and cleared of all obstructions to the flow of the tides into and out of said river, to a depth of 15 feet at low water, and reconstruct said bridge with a swing-draw in the main channel of said river, with an opening on each side of said draw, not less than 80 feet wide, for the safe and convenient passage of vessels navigating said river through the same, in such manner as the harbor commissioners shall approve.

SEC. 2. If the said city council shall elect within the time limited in the preceding section to dredge and clear the channel of said river and reconstruct said Washington Bridge in the manner prescribed in said section, the city shall cause said work to be completed to the satisfaction of the harbor commissioners within one year from the time such election shall be made by said city council; and the obligations of said city under an act entitled "An act in relation to the Providence Washington Bridge and the draws in the bridges of the Seekonk River," passed at the January session, 1859, and accepted by said city April 12, 1859, to maintain and keep in repair said Washington Bridge and draw, shall remain in full force in respect to said reconstructed bridge and draw.

SEC. 3. If the city council of the city of Providence shall not elect within the time limited in section 1, to reconstruct said Washington Bridge in the manner aforesaid, a new bridge over said river, on or near the site of said Washington Bridge, shall be built, with a swing-draw therein, with an opening on each side of said draw not less than 80 feet wide, so located with reference to the channel and currents of the river as to be most safe and convenient for the passage of vessels navigating said river through the same, in such place and manner as shall be determined by five bridge commissioners, of whom two shall be appointed by the city council of said city, two by the governor, and one by the town council of the town of East Providence. And if said new bridge shall be constructed upon the site of the present Washington Bridge, the said commissioners shall first remove the Washington Bridge and dredge and clear the channel under and near the same of all obstructions to the flow of the tides and to navigation, to a depth of not less than 15 feet at low water.

SEC. 4. The bridge commissioners so appointed shall cause, within two years from the time of their appointment, said new bridge to be constructed and completed according to plans and specifications by them approved; and when the same shall be completed and opened for public travel, the said commissioners, in case said bridge shall be on a site other than that of the present Washington Bridge, shall cause the present Washington Bridge to be removed from said river, together with the piers and piling thereof and connected therewith, and shall also cause the channel of said river to be dredged under and about said Washington Bridge and said new bridge, to a depth of not less than 15 feet at low water, and in such a manner as the harbor commissioners may direct, and deliver to said city the materials composing said bridge, piers and piling, for the use of said city.

* * * * * * * *

PAWTUCKET, R. I., June 14, 1883.

DEAR SIR: Your favor of May 22, addressed to the Pawtucket Business Men's Association, was duly received, and the undersigned, a committee appointed by said association to obtain the information desired, most respectfully submit the following statistics of the commerce in Pawtucket River for the year 1882:

Imports.

Coal	tons	86,000
Iron	do.	5,300
Gravel	do.	300
Clay	do.	50
North River stone	do.	500
Paving Stone	do.	240
Brick		2,000,000
Ammonia water	barrels	210,000
Lime	do.	2,500
Cement	do.	15,000

Long lumber	feet	9,000,000
Short lumber, as shingles, laths, clapboards, etc.	do.	8,000,000
Spool lumber (about)	do.	2,000,000

The above merchandise was received chiefly by barges and sailing vessels carrying from 150 to 600 tons each, and drawing from 7½ to 11 feet of water.

The number of water-craft passed through the draw-bridges for the year 1882 was as follows:

Steamboats	402
Tow-boats	760
Sailing vessels	413
Sail-boats	248
Miscellaneous	458
Total	2,281

We would call attention to the fact that the commerce upon the river is steadily increasing; also that extensive manufacturing establishments are now being erected upon the banks of the river, which will greatly increase the commerce upon the same, and in order to meet the demand for transportation in large barges and sailing vessels, increased facilities to navigate the Pawtucket River should be made by widening and deepening the channel and removing the obstructions.

We wish especially to call attention to an obstruction known as Seal Rock, lying nearly in the middle of the channel of the river at the head of navigation, and we hope that such recommendation will be made as will cause its removal.

All of which is most respectfully submitted.

GEO. E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee.

GEORGE H. ELLIOT,
Lieut. Col. of Engineers, U. S. A.

PAWTUCKET, August 2, 1883.

DEAR SIR: We, the undersigned committee, beg leave to submit the following supplemental report in accordance with your request to furnish additional information respecting the commerce and manufactures that would be benefited by further improvement of the Pawtucket River.

Pawtucket, situated at the head of navigation, 4 miles above Providence, becomes a distributing point for merchandise to supply an extensive inland trade.

Among the towns which draw more or less of their supplies from Pawtucket, may be mentioned East Providence, Seekonk, Rehoboth, Attleboro', Mansfield, Wrentham, Franklin, Cumberland, Lincoln, Smithfield and North Providence.

Pawtucket naturally commands the trade of the territory for half the distance to Boston and entire valley of the Blackstone River. One hundred and thirty trains over Boston and Providence, the Providence and Worcester, and the New York and New England railroads pass through this place daily. Its convenience for transportation by rail, the facility with which its citizens can reach all the large centers of business, together with its manufacturing and mechanical industries, have attracted people from various parts of the world to settle here.

The growth of Pawtucket has been rapidly increasing. In 1865 there were 5,000 inhabitants; at the present time, 1883, there are between 23,000 and 25,000. If we include the immediate villages of Central Falls, Valley Falls, Lonsdale and Saylesville, we may safely say we have a population of upward of 35,000.

Within these limits there is a great variety and a vast amount of manufacturing and mechanical industries carried on, and from which the General Government has in years past received large revenues. They paid during the fiscal year ending June 30, 1866, $636,691.98 into the office of the assessors for internal revenue for the first district of Rhode Island.

The revenue from the Pawtucket post-office for the fiscal year ending December 31, 1882, was $12,298.28, which will give you some idea of the business which is transacted here at the present time.

Pawtucket is largely a manufacturing community, and in the extent and variety of its manufactures is not surpassed by any place of equal size in the United States. It contains some of the largest establishments of their kind which are to be found in the country, among which may be mentioned the Conant Thread Company, manufacturers of the J. & P. Coats spool cotton, with a capital of $3,000,000, and employing over 2,000 operatives, and consuming in the single item of coal 20,000 tons annually.

The W. F. & F. C. Sayles bleacheries, with their manufacturing establishments, employ over 1,500 hands, and their consumption of coal per annum is 15,000 tons.

The Rhode Island Horse Shoe Company, situated in Valley Falls, in the immediate vicinity of this place, is the largest of its kind in the world, and calls for a transportation of 150 tons per day, with a consumption of 12,000 tons of coal per annum.

Without entering further into detail, we would add that not less than $25,000,000 are invested in the different manufacturing industries, all of which could not fail of being benefited by the removal of the obstructions and the improvement of the channel of the Pawtucket River.

The specific improvements needed to put the river in proper condition are the removal of the obstructions at the Railroad and Washington Bridges, the straightening, widening and deepening of the channel, so that when completed it shall have a width of 150 to 200 feet and a depth of 12 feet at low water; also the removal of Seal Rock, near the head of navigation.

Provision has been made by the State government for the removal of the present Washington Bridge and the obstructions under the same, making a depth of water of not less than 15 feet at low water; also providing for five commissioners, to be appointed by the State, the town of East Providence, and the city of Providence, to execute the foregoing provision, build a bridge in place of the present Washington Bridge, with a draw having two openings of 80 feet in width, and two years' time has been allowed the commissioners for the completion of the work. Commissioners have already been appointed by the State and the town of East Providence.

All of which is most respectfully submitted.

GEO. E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee of Pawtucket Business Men's Association.

GEORGE H. ELLIOT,
Lieut. Col. U. S. Engineers.

In making the borings in the bed of the Pawtucket, very good results were obtained by the use of a hydraulic process which was employed by Mr. A. P. Boller, the distinguished bridge engineer, in making the very deep borings (75 feet into a bottom overlaid by 50 feet of water) at the site of the proposed bridge over the Thames River, at New London, Conn. It may be thus described:

A piece of gas-pipe of the length required is driven well into the bottom. A smaller pipe, with a chisel end, through which have been drilled two small (about one-eighth inch) holes inclined downwards and outwards, is lowered through the larger pipe until it strikes the ground. A piece of hose connects the top of the interior pipe with a force-pump, from which a suction hose leads down the side of the vessel or scow used in making the borings into the water. A catch-basin is screwed to the top of the exterior pipe. When water is pumped into the inner pipe by two men at the brakes, and the pipe is turned and gently jumped up and down by a third man, the water issues through the small holes in the lower end with great velocity, and the material of the bottom is loosened and forced up with the water through the annular space between the two pipes.

The kinds of material through which the boring is made are exhibited in the catch-basin, and the depth of each is measured by the penetration of the interior pipe, to which as many lengths are added as required. In our use the interior pipe was one-half inch and the exterior pipe was 1¼-inch gas-pipe. Two-inch pipe was also used for the latter.

It should be remarked that when a stratum of gravel was encountered, the apparatus did not work as well as in soft material. It was found difficult in such cases to get the exterior pipe far enough into the bottom to prevent the water from being forced up outside, rather than inside of that pipe. The gravel also clogged the annular space between the two pipes. In gravel it is necessary to raise the interior pipe and substitute a solid end or an auger for the chisel end before described, and to drill or bore through the gravel stratum until the required depth is reached.

Improvement of Providence River and Narragansett Bay, Rhode Island.

Providence River is an estuary of Narragansett Bay, extending from Nayat Point to the city of Providence. Its length is about 7 miles and its width varies from 1,000 feet to 2 miles. At its head it is joined by the Pawtucket River, extending 5 miles further, to the town of Pawtucket. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, at one point in the channel—a place called "The Crook," at the junction of Providence River with the Pawtucket—the available low-water depth was but 4½ feet, and Bulkhead Rock, with but 7 to 8 feet of water upon it at low water, with deep water around it, was a dangerous obstruction between Pawtuxet Shoal and Field's Point.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed, during this period, to a depth of 20 feet below mean low water.

The approved project of 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Field's Points of the following dimensions in cross-section, viz.:

	Feet deep.
300 feet wide	25
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

The estimated cost of this project was $445,000. To this should be added the estimated cost—$115,000—of enlarging the channel below Field's Point, so that from this point to Sabin's Point Light there will not be less than 500 feet of width at a depth of 18 feet at mean low water, and 700 feet of width at a depth of 14 feet; and also the cost of removing Green Jacket Shoal, which occupies a very valuable portion of the harbor immediately in front of the city. It may not be thought necessary in the first instance to excavate this shoal deeper than 20 feet at mean low water, but within a short time the commerce of Providence will doubtless demand its removal to a depth of not less than 25 feet at mean low water. The cost of this work cannot be estimated before the survey required to determine the quantity, and the boring to discover the character of the material to be removed, which are now in progress, are finished.

The 25-foot channel just mentioned has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights, such as are in use in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

DESCRIPTION OF THE REACHES OF THE 25-FOOT CHANNEL, 300 FEET WIDE.

Prolongations of the various reaches of the 25-foot channel fall on the land as follows (the stone "bounds" used to permanently mark the lines are 6 inches square, with drill-holes in the centers of the tops):

Fox Point Reach.—The middle line of this reach is marked by two stone bounds on Sassafras Point, one about 100 feet from the north shore and the other on a hill about 600 feet further south.

Sassafras Point Reach.—The east line of this reach is marked on Field's Point by a stone bound set even with the surface of the ground on the slope of the hill south of the road, which bound is 87 feet southerly from the southwest corner of the Shore House, and by a point on Point Street Bridge 11.8 feet from the face of the west abutment.

Field's Point Reach.—The middle line of this reach is marked by a small drill driven into the rock and covered by a mound of small stones on the northeast end of Whortleberry Island, and by the southwest corner of the brick office of the Providence Gas Company, on the corner of Arnold avenue and Public street.

Pomham Reach.—The middle line of this reach is marked by a stone bound on the north side of Kettle Point, and by one about 400 feet from the shore near a fence which runs northeasterly from Devil's Hand Rock.

Pawtuxet Reach.—The middle line of this reach is marked by two stone bounds, one near the center of the island southeast of Pomham Light and the other on the mainland east of the railroad and about 125 feet northwest of a small red house.

Gaspee Reach.—The middle line of this reach is marked by two stone bounds, one on Conimicut Point, in open land, and the other on the south side of Field's Point, north of a group of bath-houses on the south shore of the point and about 40 feet from high-water line.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1883.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1883, including liabilities outstanding at that date, was $85,274.26, with the following results: In the six straight reaches into which the 25-foot channel had been divided, the following widths had been made: Fox Point Reach, 180 feet; Sassafras Point Reach, 230 feet; Field's Point Reach, 200 feet; in the Pomham Reach no work was done; Pawtuxet Reach, 120 feet; and Gaspee Reach, 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the excavation of the 25-foot channel was in progress, under a contract with the Atlantic Dredging Company, of Brooklyn, N. Y., described in the last Annual Report, and it continued until the 21st of November, 1883, when the contract was completed. The amount of material removed during the fiscal year was 217,724 cubic yards, including 43,016 cubic yards excavated from Long Bed, and eastward of the 25-foot channel in the Field's Point Reach, in making a depth of 20 feet at mean low water. Mr. W. C. Simmons, Jr., was local inspector of the work.

An elaborate hydrographic survey of the areas yet to be excavated, for determining the amount of material necessary to be removed in the completion of the present approved project, was made in November and December, 1883, by Assistant Engineer Norman W. Eayrs, assisted by a party in the United States schooner Surveyor. Mr. Eayrs made also a large number of borings for the purpose of ascertaining the character of the bottom within these areas, and the information gained will be incorporated in the next specifications for contracts for the work.

AMOUNT EXPENDED AND PROGRESS DURING THE LAST FISCAL YEAR.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1884, was $40,572.23.

The 25-foot channel in the Fox Point, the Sassafras Point, and the Field's Point reaches was carried to its full width of 300 feet; Pawtuxet Reach was widened to 200 feet, and work on the Pomham Reach was commenced. In addition to the above, that part of the Anchorage Basin, with a depth of 20 feet, lying to the eastward of the 25-foot channel in the Field's Point Reach, was carried as far as was contemplated in the approved project, viz., 300 feet from the axis of the 25-foot channel. It was found necessary, however, to leave a little of the point of Long Bed projecting into the 20-foot channel from the eastward, the material being found too hard for dredging with a clam-shell dredging machine, and also a small amount of what was supposed to be ledge rock (a part of Long Bed) in the 25-foot channel; but this lies so deep and so close to the eastern side of this channel that it will probably not interfere with the use of its entire width.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

It is proposed, with the available remainder of the appropriation of August 2, 1882, and the amount appropriated by the act of Congress of July 5, 1884, to carry the 25-foot channel, 300 feet wide, to the deep water of Narragansett Bay, if the funds permit, and, if any money remains, to excavate a portion of the Anchorage Basin above Field's Point, and of the beating channel for coasters and local traffic below Field's Point. It is also proposed to remove the bowlders which obstruct Providence River at the mouth of Pawtuxet River, as is provided for in the act of July 5, 1884.

A plat of Providence River accompanies this report.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected during the last fiscal year was $202,227.57. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1883, amount available		$43,190 23
July 1, 1884, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1883	$40,569 53	
July 1, 1884, outstanding liabilities	2 70	
		40,572 23
July 1, 1884, amount available		2,618 00
Amount appropriated by act approved July 5, 1884		85,000 00
Amount available for fiscal year ending June 30, 1885		87,618 00
Amount (estimated) required for completion of existing project		235,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1886		100,000 00

COMMERCIAL STATISTICS.

PROVIDENCE BOARD OF TRADE,
SECRETARY'S OFFICE,
PROVIDENCE, June 16, 1884.

SIR: In reply to your favor of 7th instant, I have the honor to hand you some statistics of this port for the year 1883.

By comparison with the reports of former years, you will observe that, notwithstanding the extreme business depression of the past year, the aggregate tonnage of the merchandise received at this port has increased, while the number of vessels arriving has slightly decreased, thus further illustrating the fact to which I alluded in a previous communication, that the size of the vessels used in our coastwise traffic is steadily increasing, making it absolutely necessary that the work on our river and bay that has been so auspiciously commenced should be completed as soon as practicable. If I can be of any further service to you, please command me.

Your obedient servant,

CHAS. H. MERRIMAN,
President.

GEO. H. ELLIOT,
Lieut.-Col. of Engineers.

P. S.—I do not mention the exports coastwise of Providence, because it is not in my power to get accurate statistics of them, as they consist principally of manufactures of cotton, wool, iron, etc., coming not only from our own city and State, but from all of central New England, constituting the freight of the lines of steamers from this port to New York, Philadelphia, Norfolk and Baltimore. The value of these cargoes exceeds $500,000 daily, and it is their protection that demands every possible improvement in our harbor and bay.

Yours truly,

C. H. MERRIMAN,
President.

SHIPPING AT THE PORT OF PROVIDENCE, RHODE ISLAND, FOR THE YEAR 1883.

Arrivals, foreign, 60, of which 20 were American, bringing—

Lumber	feet	2,612,000
Shingles		5,440,600
Laths		704,100
Pickets		22,000
Potatoes	bushels	3,500
Salt	pounds	8,351,610
Logwood	tons	1,834
Piling		650
Brimstone	tons	1,136
Molasses	gallons	144,237
Scrap iron	tons	885

Pig iron	tons	700
Shipping coastwise		4,918
Cotton	bales	220,317
Wool	bales	38,581
Flour	barrels	4,595
Grain	bushels	1,299,871
Coal	tons	869,722

TONNAGE OF THE PORT OF PROVIDENCE.

	Tons.
110 sail vessels	15,697.44
27 steam vessels	19,981,63
Tonnage of coastwise arrivals	2,567,000

LETTER OF COLLECTOR OF CUSTOMS AT PROVIDENCE, RHODE ISLAND.

CUSTOM-HOUSE, PROVIDENCE, R. I.,
Collector's Office, June 30, 1884.

SIR: In compliance with the request contained in your letter of the 12th instant, I forward herewith statistics of the trade and commerce of this port for the year ending this day.

Very respectfully,

CYRUS HARRIS,
Collector.

GEO. H. ELLIOT,
Lieut.-Col. of Engineers.

RIVER STATISTICS FOR THE PORT OF PROVIDENCE FOR THE YEAR 1883.

NUMBER AND TONNAGE OF VESSELS SAID TO BELONG TO THE PORT.

Description.	Number.	Tons.
Sail vessels of 20 tons and upwards	54	12,879.90
Steam vessels of 20 tons and upwards	20	18,453.11
Sail vessels under 20 tons	46	402.03
Steam vessels under 20 tons	6	98.36
Barges	2	701.04
Total tonnage	128	32,534.44

ARRIVALS BY THE MONTH, ACCORDING TO MARINE REPORT.

January	257	July	563
February	245	August	570
March	323	September	549
April	418	October	401
May	442	November	368
June	518	December	349

Arrivals for the year	5,003
Arrivals of under 20 tons licensed, but not reported	2,704
Excursion steamers not reported	547
Tugs with tows not reported	298
	8,552
Vessels sailed	8,552
Total arrived and sailed	17,104

Making a total of 17,104 vessels that passed up and down Providence River during the year 1883, the tonnage of which is estimated to be 4,522,768 tons.

* * * * * * * *

RECAPITULATION.

Whole number of vessels belonging to the port	128
Tonnage of same	32,534
Arrivals for the year	8,552
Vessels sailed	8,552
Tonnage of same	4,522,768
Tons of freight received and shipped	1,539,554
Passengers	549,711

Of the above, it is known that the following have gone to Pawtucket, R. I., after their arrival at this port:

180 cargoes of coal	tons	78,306
36 cargoes of lumber	do.	6,022
12 cargoes of brick	do.	1,513
Passengers		31,199

The following articles were received by way of the river:

Cotton	bales	221,897
Wool	do.	38,860
Flour	barrels	4,676
Grain	bushels	1,314,565
Coal	tons	952,747
Greatest single tonnage		2,888.20
Greatest draught of water		22.6

ROBERT A. TURNER,
Inspector, &c.

N. B.—The number of thousands of passengers carried to and from this port by the Fall River line of steamers I have been unable to obtain; therefore the number of passengers given is short accordingly.

R. A. T.

Improvement of Newport Harbor, Rhode Island.

This harbor is on the main entrance to Narragansett Bay. It is one of the most important harbors on the coast, providing a safe roadstead and anchorage. Newport itself is upon an inner harbor, separated from Narragansett Bay by Goat Island and a breakwater which extends northerly from the island about 1,400 feet. The mean rise and fall of the tide is about 3¼ feet.

ORIGINAL CONDITION.

Before improvement, the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched across it from Goat Island to Lime Rock, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project for the improvement and its modification of December 14, 1880, under which work is now being carried on, provided for a channel 15 feet deep at mean low water, through the bar which stretches across the southern entrance from Lime Rock to Goat Island; a channel 300 feet wide and 13 feet deep at mean low water from the 13-foot curve to Commercial Wharf; thence outside of and along the harbor line south a channel 100 feet wide and 12 feet deep at mean low water; a channel north from Commercial Wharf, outside of and along the harbor line to a point opposite Bull's Wharf, of the same dimensions, and thence to Long Wharf a channel 100 feet wide and 7 feet deep at mean low water. It also provided for cutting off the point of the spit at the south end of Goat Island and the construction of a jetty on the southwest shore of that island to arrest the drift of the littoral sand and gravel into the entrance. It was also intended to deepen the following areas to 13 feet at mean low water, where the material of the bottom was not hard, and to lesser depths when hard pan and rock might be encountered: The area included between the 13-foot curve, Commercial Wharf on the north, the harbor line on the east, and a line drawn from Perry Mill Wharf to Lime Rock, and the area included between the 13-foot curve and a line drawn from the northwest corner of Commercial Wharf to the southwest corner of Long Wharf; also to deepen to 10 feet at mean low water the area northwest of a line drawn from Lime Rock to the spindle in the southeast part of the harbor, and the area between the harbor line and a line drawn from the northwest corner of Commercial Wharf to the southwest corner of Long Wharf.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1883.

The amount expended up to the close of the fiscal year ending June 30, 1883, including liabilities outstanding at that date, was $73,141.23, with the following results: A jetty on the southwest shore of Goat Island 150 feet long has been constructed, and the northern angle between it and the shore quickly filled with sand and gravel, showing its utility. A considerable portion of the spit south of Goat Island has been excavated, first to 12 feet, then to 13 feet, at mean low water; the channel from the 13-foot curve to the harbor line at Commercial Wharf and the channel outside of and along the harbor lines have been excavated as contemplated, but varying somewhat from the originally projected dimensions, and with the addition of a channel 50 feet wide and 12 feet deep at mean low water along the northern side of the harbor out to deep water; many large bowlders have been removed from the bed of the harbor; its anchorage areas of from 11 to 13 feet depth at mean low water have been increased by about 26 acres, and the distance between the 13-foot curves at the southern entrance has been widened about 250 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

For want of funds, no operations have been in progress during the last fiscal year, except a survey by Assistant Engineer Norman W. Eayrs to determine the amount, and borings to discover the character of the material, of the bed of the harbor yet to be excavated, for use in the preparation of specifications for future contracts for carrying on the work.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

With the available remainder of the appropriation of August 2, 1882, and the appropriation made by act of Congress of July 5, 1884, it is proposed to excavate to not less than 15 feet depth at mean low water, and to such width as may be necessary, at the southern entrance to the harbor, and to 13 feet depth within the harbor; to remove the bowlders recently discovered on the bed of the harbor; to repair the jetty on the southeast shore of Goat Island, and to construct a new jetty further north on the same shore.

The estimated cost of the project under which we are now working was $132,000. Of this amount, there has been appropriated the sum of $65,000.

A plat of Newport Harbor accompanies this report.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected in the last fiscal year was $3,383.87. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, Rhode Island.

MONEY STATEMENT.

July 1, 1883, amount available	$358 77
July 1, 1884, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1883	297 97
July 4, 1884, amount available	60 80
Amount appropriated by act approved July 5, 1884	20,000 00
Amount available for fiscal year ending June 30, 1885	20,060 80
Amount (estimated) required for completion of existing project	67,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1886	50,000 00

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, NEWPORT, R. I.,
Collector's Office, July 14, 1884.

SIR: I have the honor to acknowledge the receipt of your letter of the 7th ultimo.

During the year ending June 30, 1884, about 5,000 vessels of all classes have arrived at this port, either for a harbor or to discharge cargoes. This includes steam and sail vessels engaged in coasting trade, fisheries and yachting.

During the year ending June 30, 1884, nine vessels have entered this port from foreign ports and discharged their cargoes. Nine vessels have cleared from this port for foreign ports, one of them carrying a full cargo.

The cargo shipped from this port consisted of—

Articles.	Quantity.	Value.
Fish guano ... tons..	118	$2,950
Shooks ... bundles..	1,500	1,500
Staves and headings ... do.....	300	900
Iron tanks	2	202
Carriage	1	536
Total		6,088

The cargoes from foreign ports consisted of—

Spruce boards	feet..	551,336
Spruce laths	pieces..	1,556,700
Shingles		250,000
Hemlock boards	feet..	110,000

During the year there has been landed at this port say—

Coal	tons	38,000
Shingles		3,500,000
Laths		2,250,000
Lumber	feet	9,000,000
Lime	barrels	8,000
Cement	do	4,500
Bricks		3,500,000
Cotton	bales	1,500

The amount of revenue collected in this district from duties on imports, tonnage-tax, marine-hospital tax, inspection of steam vessels, and miscellaneous receipts for the year ending June 30, 1884, is $3,383.87.

There are 128 vessels owned in and hailing from this port, viz., 114 sail and 14 steam.

The gross tonnage of the 128 vessels is 5,384.52 tons; the net is 4,210.55 tons. The tonnage of the largest vessel is 708.69 tons gross; 678.26 tons net. The tonnage of the smallest vessel is 2.75 tons gross; 2.17 tons net. The largest vessel draws 13 feet when loaded.

Trusting the statistics above referred to are sufficient for your purpose,

I remain, respectfully,

J. H. COZZENS,
Collector.

Lieut. Col. GEO. H. ELLIOT.

LETTER OF THE SUPERVISOR OF THE OLD COLONY STEAMBOAT COMPANY.

OLD COLONY STEAMBOAT COMPANY,
Newport, R. I., June 17, 1884.

SIR: I am in receipt of your circular letter dated June 7, 1884, citing certain requirements of the Secretary of War relative to commerce and navigation, and asking me to furnish you aggregate statements of freight and passengers to, from, and through this harbor (Newport) by the steamers of the Old Colony Steamboat Company during the year 1883.

I respectfully submit the amount of freight carried by the steamers of this line to, from, and through this harbor during the year to be about 250,000 tons, and the number of passengers to be about 270,000.

By way of other recommendation, I cannot now do better than refer you to the following extract from my letter of August 20, 1883, in reply to your inquiry on this same subject under date of July 14, 1883, in which it is stated "that inasmuch as the steamers of this line have been frequently detained in the channel between Lime Rock and Goat Island at low tide drawing 13 feet of water; that an additional 2 feet or a total depth of 15 feet is necessary at all times to meet the requirements of the draught of water of the steamers of this line. The depth of water in channel as indicated on chart at mean low water is 13 feet; but inasmuch as there are times, particularly in stormy weather, that there would be instead of 18 feet, as marked on chart, but 12 feet of water in mid-channel, I would suggest dredging the channel until a depth of 15 feet is obtained below your present low-water mark. This would insure plenty of water at all times of tides for vessels drawing 13 feet to pass through. Any of the steamers of this line with an ordinary load will ground in present channel at extreme low water."

GEORGE PIERCE,
Supervisor Old Colony Steamboat Company.

GEORGE H. ELLIOT,
Lieut. Col. of Engineers, U. S. A.

LETTER OF THE SUPERINTENDENT OF THE NEWPORT AND WICKFORD RAILROAD AND STEAMBOAT COMPANY.

SUPERINTENDENT'S OFFICE,
NEWPORT AND WICKFORD RAILROAD AND STEAMBOAT COMPANY,
Newport, R. I., June 11, 1884.

DEAR SIR: Your letter of the 9th instant is before me, and I have to say, in reply to your inquiries, that there were carried by the steamers of this line during the year 1883, 65,168 passengers; also, 1,690 tons merchandise.

All of which is respectfully submitted.

Yours truly,

THEO. WARREN,
Superintendent.

GEO. H. ELLIOT,
Lieut. Col. of Engineers.

Harbor of Refuge at Block Island, Rhode Island.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles south of the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station, connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. A plat of the harbor was published in the Annual Report of the Chief of Engineers for 1880, page 390.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge, Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden. The mean rise and fall of the tide is about 8 feet.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor for the protection of small vessels and an exterior harbor for large ones. The former was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening 80 feet wide on the seaside, by timber crib-work filled with stones and resting on a rip-rap foundation. The exterior harbor was to be formed by a rip-rap breakwater, designed to intercept the waves from the eastward, and the beds of both harbors were to be cleared of bowlders.

The next project (1881) was to build a masonry wall on the east side of the Inner Harbor in lieu of the old crib-work on that side, which was in danger of breaking down in storms, and also to protect the cliff which lies to the eastward of the harbor, the material of which was carried by the current into the harbor, decreasing its depth.

The last project for this work provided for renewing the Government wharf within the Inner Harbor, and for building masonry walls on the north and west sides of the harbor to replace the timber crib-work on those sides, which is decaying.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1883.

The Inner Harbor and a breakwater about 1,400 feet long, built in prolongation of the eastern side of the Inner Harbor, were constructed in the years 1870 to 1879, inclusive. About 300 feet from the sea end of the breakwater, which is in about 24 feet of water, an opening 200 feet wide, with a draught of water through it of 18 feet, was left for the passage of vessels. The utility of the work at once became apparent. In stormy weather the Inner Harbor especially was often filled with coasters and fishermen, and it soon became necessary to increase its depth from 7 feet, to which it had originally been dredged in the first instance, to 9 feet at mean low water. The jetty at the foot of the cliff and the masonry sea-wall on the eastern side of the Inner Harbor were in progress on the 30th of June, 1883, and the total expenditure from the beginning of the construction of the harbor of refuge up to that date, including liabilities outstanding, had been $295,-896.83.

OPERATIONS DURING THE LAST FISCAL YEAR.

The operations of the last fiscal year were confined to the completion of the construction of a sea-wall on the eastern side of the Inner Harbor and of the rip-rap jetty at the foot of the cliffs.

The landing wharf within the Inner Harbor was repaired during the year, and the decayed wharfing on the eastern side of the Inner Harbor was removed.

Mr. Joseph E. Cranston was the local inspector of the work from April 10 to September 30, 1883, and Mr. A. H. Dickens from November 14 to December 29, 1883.

AMOUNT EXPENDED AND PROGRESS DURING THE LAST FISCAL YEAR.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1884, was $10,963.65, and the result was the completion of the jetty at the foot of the cliffs and the sea-wall on the eastern side of the Inner Harbor. Both were strongly built. The former is about 140 feet and the latter about 290 feet long. The landing wharf within the Inner Harbor was repaired sufficiently to serve until a permanent wharf can be constructed.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

It is proposed, with the available remainder of the appropriation of August 2, 1882, and the amount appropriated by the act of Congress of July 5, 1884, to replace the Government wharf within the Inner Harbor by a substantial structure. To this wharf, which is in a decayed condition, all the freight carried to and from the island is brought, and at it are landed the United States mails and all the supplies for the four light-houses on the island and the steam siren (fog-signal).

It is also proposed to fill the gap in the breakwater to exclude the heavy sea which now rolls through it, in easterly storms, into the anchorage, and of which complaint is made.

The estimated cost of the last project was $30,000. Of this amount, there has been appropriated the sum of $15,000.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge for coasting vessels. There are three light-houses on the island, the north and south lights and the breakwater light. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1883, amount available		$14,103 67
July 1, 1884, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1883	$10,952 48	
July 1, 1884, outstanding liabilities	11 17	
		10,963 65
July 1, 1884, amount available		3,140 02
Amount appropriated by act approved July 5, 1884		15,000 00
Amount available for fiscal year ending June 30, 1885		18,140 02
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1886		15,000 00

COMMERCIAL STATISTICS.

BLOCK ISLAND, R. I., June 30, 1884.

MY DEAR SIR: Your circular letter of June 7, stating that "the act of Congress of June 23, 1866, referring to works of river and harbor improvement, requires the Secretary of War to state annually, and as far as practicable, what amount of commerce and navigation would be benefited by the completion of each particular work," and that "you were directed to furnish, with your reports of the river and harbor works in this district, statements of the staple articles of freight, such as coal, iron, cotton, grain, lumber, and other merchandise received and shipped, and of the character, number, tonnage, draught, &c., of vessels, whether steam or sail, which arrived and departed during the same time," was received by me in due time and has received my careful consideration. Inclosed please find my report, which I do not claim to be correct, but will be quite as near as it is possible to get it with no data to refer to.

Trusting that the report may answer both your and the Department's purposes,

I remain, yours very respectfully,

NICHOLAS BALL.

Lieut. Col. GEORGE H. ELLIOT.

AMOUNT OF MERCHANDISE RECEIVED AND EXPORTED FROM BLOCK ISLAND DURING THE YEAR ENDING DECEMBER 31, 1883.

Coal received, about	tons..	3,500
Iron received, about	do...	100

Grain received, about	bushels..	9,500
Lumber received..	feet..	2,500,000

General merchandise, not included in the above, shipped and received, 10,000 tons.

Arrivals and departures of steam vessels, 1,500, of from 1,000 to 50 tons, and from 3 to 10 feet draught; arrivals and departures of sailing vessels, 105,000, of from 10 to 200 tons, and from 2 to 10 feet draught.

Improvement of Little Narragansett Bay, Rhode Island and Connecticut.

Little Narragansett Bay lies on the north side of the eastern entrance from the ocean into Long Island Sound, and is inclosed on the southern and eastern sides by a long and narrow tongue of land, extending from the mainland at Watch Hill, first westerly and then northerly, to the entrance to the bay, which is from the outer harbor of Stonington. Pawcatuck River, upon which is situated the flourishing commercial and manufacturing town of Westerly, R. I., empties into the eastern side of the bay, and has been improved by the United States. A map of Little Narragansett Bay was published in the Annual Report of the Chief of Engineers for 1879, page 314.

ORIGINAL CONDITION.

The navigable draught of water through the bay before improvement was about 4½ feet at mean low water, and this depth limited the navigation of Pawcatuck River.

PLAN OF IMPROVEMENT.

The project of 1878 for the improvement of the bay provided for a channel 200 feet wide and 7½ feet deep at mean low water, extending from the entrance to the bay to the mouth of the Pawcatuck, and the removal of the bowlders which then obstructed navigation, and any others which the excavation of the channel might develop. Subsequently it was determined to clear away some large bowlders which interfered with steamboat navigation between this channel and Watch Hill, an important place of summer resort. The estimated cost of the improvement was $51,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1883.

The amount expended up to the close of the fiscal year ending June 30, 1883, including liabilities outstanding at that date, was $34,864.16, and the result was the completion of the project, with the exception of the removal of bowlders from the bottom and sides of the Main Channel and from the channel leading to Watch Hill.

AMOUNT EXPENDED AND RESULTS DURING THE LAST FISCAL YEAR.

During the last fiscal year the amount expended, including liabilities outstanding on June 30, 1884, was $992.80, and the result was the removal of about one hundred bowlders from the Main and Watch Hill channels, and some ledge rock from the latter. The Main Channel was left quite free from bowlders, and the Watch Hill Channel was increased by the removal of bowlders from 90 to 165 feet in width. It is probable that no further expenditures will be required upon it.

The completed channel will enable steamers and vessels drawing from 9 to 10 feet of water bound for the Pawcatuck River and Westerly, and also to Watch Hill, to cross the bay. Mr. A. H. Dickens was local inspector of the work. The total cost of the improvement was $35,856.96. No further appropriation is asked for this work.

There are indications that the construction of the eastern breakwater in the outer harbor of Stonington is affecting Sandy Point, on the southern side of the entrance into Little Narragansett Bay, and comparative surveys should be made annually at this point. Range-marks should be erected on Pawcatuck Point, on the prolongation of the axis of the new channel through the bay, and the remainder of the last appropriation now available should be reserved for these purposes.

Little Narragansett Bay is in the collection district of Providence and Stonington, the dividing line passing through the bay. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $202,227.57; Stonington, $8,418.23. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1883, amount available		$1,135 84
July 1, 1884, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1883	$986 33	
July 1, 1884, outstanding liabilities	6 47	
		992 80
July 1, 1884, amount available		143 04

Preliminary Examination of Pawtuxet Harbor, Rhode Island.

In compliance with the requirements of the river and harbor act of August 2, 1882, I visited Pawtuxet, R. I., October 27, and made a personal inspection of the harbor.

This harbor is at the mouth of the Pawtuxet River, a small stream which enters Narragansett Bay from the west, about 5 miles south of Providence. The river has considerable fall just before entering the bay, and at this point a dam has been built, above which the tide does not flow. The harbor proper is about 600 yards in its longest dimension (north and south) and 150 yards wide; it is well sheltered, being protected from the east along its entire length by a high rocky peninsula. Off the end of this peninsula and in the mouth of the harbor are a number of bowlders which obstruct the entrance and render its navigation difficult and dangerous. The current from the river enters and crosses the harbor near its upper end; it is then deflected to the west shore and back again to the east; this action produces a series of bends in the channel where the depth is sufficient, with shoal spots between.

The improvement desired is the removal of these shoals and of the bowlders at the harbor's mouth. Should this be accomplished, the harbor would be a convenient one for the business of the place, which, though not large, I am told by those interested is of considerable importance. The principal industry carried on is the fish and oyster business. The village and adjoining country receive by water their supply of coal and building materials, which now they are obliged to land by means of scows. There is one factory in the place producing cheap jewelry in large quantities. The water-power was formerly valuable, but has suffered by the supply having been diverted to the city of Providence.

This harbor would appear to be one of those where the interests involved, though small, are really of a public character, and one which would be worthy of improvement provided the cost, determined by a survey, is found to be moderate. It is sought by a variety of small craft, and it is believed that, if improved, the navigation would be considerably increased.

The nature of the improvement is dredging and the removal of the before-mentioned bowlders, and the result, it is believed, would be reasonably permament. I have, therefore, to recommend that a survey be made to ascertain the cost of the necessary work; the sum of $200 is sufficient for the survey and map.

Respectfully submitted,

J. W. Barlow,
Major of Engineers.

New London, Conn., November 10, 1882.

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State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, 1886.

PROVIDENCE:
E. L. FREEMAN & SON, STATE PRINTERS.
1886.

State of Rhode Island and Providence Plantations.

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1886.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submit their Tenth Annual Report:

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed J. Herbert Shedd, of Providence, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

HARBOR LINES.

The position of the harbor line near India street, in the city of Providence, easterly of Fox Point, was defined by an act of the General Assembly, passed April 10, 1885.

A harbor line in North Kingstown, from Quonset Point to Bissell's Cove, including Wickford Harbor, was established by an act passed April 14, 1885. Under this act the jurisdiction of the Harbor Commissioners is extended within the harbor lines about four miles.

There is, in the opinion of this Board, urgent need of the establishment of harbor lines in the Pawcatuck river, at Westerly, but further action by the General Assembly is necessary before this can be done.

ENCROACHMENTS AND DUMPING.

Offenders under this head have been prosecuted, and every effort is made to prevent the injurious practices, though the difficulty in securing evidence sufficient for conviction undoubtedly allows the escape of some of the violators of the law. Constant care in supervision is maintained in order to keep the encroachments at a minimum.

BOUNDARY LINES.

On the sixth of March, 1885, a communication was addressed to the General Assembly by this Board, calling attention to a serious impediment to the improvement of commercial facilities along the shores of Providence harbor, by reason of the uncertainty as to the location of the boundary lines dividing the rights of one riparian owner from those of the owners adjoining him. On the twenty-fourth of April an Act for the Settlement and Determination of the Boundary Lines of Land covered by Public Tide Water, was passed by the General Assembly, and this important measure enables proceedings to be economically taken for the determination of such lines.

PAWTUCKET RIVER.

The navigation of this river has been much improved by the removal of the old Washington bridge and neighboring obstructions. Dredging by the U. S. Government was commenced in August and continued to December, during which time 180,355 cubic yards of material were removed, giving a channel one hundred feet wide and twelve feet deep, from the deep water at Red Bridge to the bend opposite Swan Point and Bucklin's Island. The large interests centering at Pawtucket seem to require a better passage for vessels at the Railroad bridge at India Point than is now available. Only one draw opening can now be used there, and that is not in the middle of the channel.

LICENSES, ETC.

Licenses have been issued as follows:

No. 57. March 25, to Eudora B. Beynon, Ada A. Wright and Walter R. Pettis, for the erection of a wharf at Pawtuxet, in Cranston.

No. 58. April 9, to Stillman B. Doane, to rebuild the wharf at the foot of Planet street, in the city of Providence.

No. 59. June 3, to the Providence Dry Dock and Marine Railway Company, to build a wharf, and dredge about it, near Bold Point, in East Providence, northerly from the Wilkesbarre Pier.

No. 60. June 10, to Alanson Alexander, to build a stone wharf wall in Pawtuxet Cove, in Cranston.

No. 61. June 10, to the Continental Steamboat Company, to repair with new piling the wharf at the foot of Hay street, in the city of Providence.

No. 62. August 5, to George F. Leete, to make repairs on the Columbia Mills Wharf on Dyer street, near Peck street, in the city of Providence.

No. 63. September 30, to Joseph Provuncher, to build a Marine Railway on Seekonk river, in East Providence.

No. 64. October 14, to Alexander Duncan, to rebuild Duncan's Wharf at the foot of Hay street, on Dyer street, in the city of Providence.

No. 65. November 25, to the Town of East Providence, to build a retaining wall of timber along the shore southerly from the India Point Railway bridge in East Providence.

Assent has been given as follows:

1. May 21, to the Continental Steamboat Company, for building a wharf at Golden Spring, Vue de L'Eau, East Providence.
2. May 21, to the Continental Steamboat Company, to repair with new piling their wharf at Rocky Point, in Warwick.
3. May 21, to the Continental Steamboat Company, to repair with new piling their wharf at Bullock's Point, in East Providence.
4. June 3, to Conant Thread Company, to do dredging near their wharf property, in Pawtucket.

5. September 2, to G. M. Long & Co., to erect a wharf on a portion of the Thomas W. Kelton farm, owned by petitioners, in Warwick.

WORK UNDER U. S. ENGINEER.

By the courtesy of Lieutenant-Colonel George H. Elliot, Corps of Engineers, we have been furnished with a report of the work done in Rhode Island waters since June 30, 1885, which will be found in the Appendix. We are also indebted to Col. Elliot's kindness for a copy of his report to the Chief of Engineers, U. S. A., for 1885, from which we have made extracts in relation to the work in Rhode Island waters under his charge previous to July, 1885, which will be found in the Appendix.

Respectfully submitted,

J. HERBERT SHEDD,
LUCIUS B. DARLING, } Harbor Commissioners.
HENRY C. BRADFORD,

APPENDIX.

ENGINEER'S OFFICE, U. S. ARMY,
NEWPORT, R. I., February 17, 1886.

MR. J. HERBERT SHEDD,
Providence, R. I.

SIR: In reply to your note of the 13th inst., I send you a copy of my last annual report, giving an account of operations to June 30th, 1885. Since that date work has been done at the following places in Rhode Island, as stated below:

(1.) Pawtucket River.
(2.) Newport Harbor.
(3.) Block Island.

(1.) *Pawtucket River.*

Dredging, under the contract referred to in the report, was commenced Aug. 7th, 1885, and was continued uninterruptedly until December 7th, when the accumulation of ice in the river compelled the suspension of further work until spring. During that time 180,855 cubic yards of material have been removed, giving a channel 100 feet wide and 12 feet deep at mean low water, from the deep water just above Red Bridge to the bend in the channel between Swan Point Wharf and Bucklin's Island. The dredged material was towed down the river to the dumping ground in the deep water of Narragansett Bay below Prudence Island.

(2.) *Newport Harbor.*

At the date of my last annual report, dredging was in progress in the anchorage area in the harbor, under the contract therein mentioned. During the first week in July, the dredge was placed upon the shoal at the south end of Goat Island, between that island and Lime Rock Light, and dredging was done there until Sept. 7th, the date of completion of the contract. During that time 20,186 cubic yards of gravel and clay were removed, widening the main channel at that place 420 feet, and giving a least depth of 15 feet at mean low water.

During October and November the jetty which was built some years ago, on the south-west end of Goat Island, was reconstructed. This jetty was for the purpose of arresting the movement of sand and gravel which was carried along the western shore of the island and deposited in the channel south of the island. It had become damaged by the action of the waves and ice. The jetty is now rebuilt in a compact manner, and has been extended about 15 feet, or to a distance of 185 feet from the shore.

(3.) *Block Island.*

At the close of the fiscal year, June 30, 1885, work was being carried on under a contract with James Scully, of Groton, Conn. The contract required the delivery of about 8,000 tons of stone, and the placing the same in the gap which had been left in the breakwater for the accommodation of fishermen, but was found to let too much sea into the sheltered area. Mr. Scully's contract was completed Aug. 29, 1885. The gap is now closed through its entire length, but is not filled to the full height and width of the remainder of the breakwater. The average height of the filling in the gap is about two feet above mean high water.

Currents in Providence River.

In June, 1885, some float observations were made in Providence River between Field's Point and Starvegoat Island, during the flood and ebb tides of two days, to determine if there was any eddy of sufficient strength to force the current flowing out by Field's Point to the eastward. It was impracticable with the means at my disposal to make any very extended series of observations. The results obtained, however, showed that there was an eddy, but not of sufficient strength to seriously influence the outflowing current. When work re-commences in the river, additional experiments will be made.

I have called at your office in Providence several times, to tell you, verbally, about these current observations, but I have had the misfortune to find you absent.

Very Respectfully,

GEORGE H. ELLIOT,

Lieut.-Col. of Engineers.

EXTRACT FROM REPORT OF LIEUT.-COL. ELLIOT TO CHIEF OF ENGINEERS, U. S. A., FOR 1885.

IMPROVEMENT OF PAWTUCKET RIVER. RHODE ISLAND.

The Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a distance of about 4¼ miles, and forms a tidal basin of about 1¼ square miles. The continuation of the river above Pawtucket is called the Blackstone River, and is not navigable. Extensive manufactories are carried on at Pawtucket, which has a population of about 30,000.

ORIGINAL CONDITION.

Before improvement, the channel in the river had a ruling depth of about 5 feet at mean low water. The mean rise and fall of the tide is about 5 feet.

PLANS OF IMPROVEMENT.

The original project for the improvement of this river provided for a channel 75 feet wide and 7 feet deep at mean low water.

This project was completed in the years 1868-'76.

The approved project of 1883 provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water, from the deep water above Red Bridge to the ledge opposite Grant & Co.'s wharf, at Pawtucket; thence, the excavation by blasting of a channel through the ledge at Pawtucket Bridge of the same depth, and 40 feet wide.

A plat of the river showing the lines of the new channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1884.

The amount expended to June 30, 1884, was $51,476.38.

The channel has been excavated to a width of 75 feet and a ruling depth of 7 feet at mean low water. In August, 1883, a thorough survey was made, in compliance with the river and harbor act of Congress of August 2, 1882, and a project was submitted for the further improvement required by the increased navigation of the river.

OPERATIONS DURING THE LAST FISCAL YEAR.

Under the authority of the Act of Congress. of July 5, 1884, appropriating $50,000.00 for the work, advertisements were issued for dredging a channel 100 feet wide and 12 feet deep at mean low water, commencing at the deep water above Red Bridge and extending as far up the river as the available funds would pay for, and the specifications for the work were printed and distributed. The following proposals were received and were opened September 23, 1884:

NAMES AND ADDRESSES OF BIDDERS.	Price per cubic yard.
	Cents.
Elijah Brainard and Thomas H. Benton, New York City	21
Atlantic Dredging Company, Brooklyn, N Y	21⅛
P. Sanford Ross, Jersey City, N. J	21¼
National Dredging Company, Wilmington, Del	21 9-10
George C. Forbes & Co., Baltimore, Md	23
Moore & Wright, Portland, Me	24
J. Boynton, Newport, R. I., and Lyman Boynton, Boston, Mass	26
John McDermott, Cohoes, N. Y,	26
Richard M. Payn, Albany, N. Y	26⅞

With the approval of the Chief of Engineers, the contract was awarded to Mr. Elijah Brainard and Mr. Thomas H. Benton, the lowest bidders; contract dated October 16, 1884, to be commenced within ten days after removal of Washington Bridge, and completed within nine months after date of commencement. There being no nearer available dumping place for the dredged material than below Prudence Island, in Narragansett Bay, and the old bridge over the Pawtucket below the work, known as the Washington Bridge, forming an obstruction to the passage of tows of loaded scows that was difficult and dangerous, the specifications for the work did not require it to commence before ten days after the removal of this bridge, which had been provided for by a law of the State of Rhode Island. The work of removal commenced in June, 1884, but at the end of the fiscal year it had not been completed, and the work on the new channel had not been commenced.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

It is expected that the removal of Washington Bridge will be completed and that the work under the current contract will be commenced within a few weeks, and that the contract will be completed in the time agreed on, viz: within nine months from the removal of the bridge, or before the first of May, 1886, exhausting the appropriation.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $201,977.87. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort at Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1884, amount available	$529 58
Amount appropriated by act approved July 5, 1884	50,000 00
	50,529 58
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,242 06
July 1, 1885, amount available	49,287 52
Amount (estimated) required for completion of existing project	882 478 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	75,000 00

Submitted in compliance with requirements of Section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

PAWTUCKET, July 1, 1885.

DEAR SIR: I am in receipt of your communication of June 15. In reply, it is my opinion that the statistics furnished last year, of which you undoubtedly have a copy, are sufficiently accurate for the purpose named. I believe, owing to the great depression in business, that the showing would not be materially changed.

Respectfully yours,

GEO. E. NEWELL.

Lieut. Col. GEORGE H. ELLIOT,
Engineers U. S. A.

COMMUNICATIONS FROM THE PAWTUCKET, RHODE ISLAND, BUSINESS MEN'S ASSOCIATION.

1

PAWTUCKET, R. I., June 14, 1883.

DEAR SIR: Your favor of May 22, addressed to the Pawtucket Business Men's Association, was duly received, and the undersigned, a committee appointed by said association to obtain the information desired, most respectfully submit the following statistics of the commerce in Pawtucket River for the year 1882:

IMPORTS.

Coal	tons	86,000
Iron	do.	5,300
Gravel	do.	300
Clay	do.	50
North River stone	do.	500
Paving stone	do.	240
Brick		2,000,000
Ammonia water	barrels	210,000
Lime	do.	2,500
Cement	do.	15,000
Long lumber	feet	9,000,000
Short lumber, as shingles, laths, clapboards, &c		3,000,000
Spool lumber, (about)	feet	2,000,000

The above merchandise was received chiefly by barges and sailing vessels carrying from 150 to 600 tons each, and drawing from 7½ to 11 feet of water.

The number of water-craft passed through the draw-bridges for the year 1882 was as follows:

Steamboats	402
Tow-boats	760
Sailing vessels	413
Sailboats	248
Miscellaneous	458
Total	2,281

We would call attention to the fact that the commerce upon the river is steadily increasing; also that extensive manufacturing establishments are now being erected upon the banks of the river, which will greatly increase the commerce upon the same, and in order to meet the demand for transportation in large barges and sailing vessels increased facilities to navigate the Pawtucket River should be made by widening and deepening the channel and removing the obstructions.

We wish especially to call attention to an obstruction known as Seal Rock, lying nearly in the middle of the channel of the river at the head of navigation, and we hope that such recommendation will be made as will cause its removal.

All of which is most respectfully submitted.

Geo. E. Newell,
Geo. P. Grant,
Henry E. Jenks,
Committee.

George H. Elliot,
Lieut. Col. of Engineers, U. S. A.

2.

Pawtucket, August 2, 1883.

Dear Sir: We, the undersigned committee, beg leave to submit the following supplemental report in accordance with your request to furnish additional information respecting the commerce and manufactures that would be benefited by further improvement of the Pawtucket River.

Pawtucket, situated at the head of navigation, 4 miles above Providence, becomes a distributing point for merchandise to supply an extensive inland trade. Among the towns which draw more or less of their supplies from Pawtucket may be mentioned East Providence, Seekonk, Rehoboth, Attleboro', Mansfield, Wrentham, Franklin, Cumberland, Lincoln, Smithfield, and North Providence.

Pawtucket naturally commands the trade of the territory for half the distance to Boston and entire valley of the Blackstone River. One hundred and thirty trains over Boston and Providence, the Providence and Worcester, and the New York and New England railroads pass through this place daily. Its convenience for transportation by rail, the facility with which its citizens can reach all the large centres of business, together with its manufacturing and mechanical industries, have attracted people from various parts of the world to settle here.

The growth of Pawtucket has been rapidly increasing. In 1865 there were 5,000 inhabitants; at the present time, 1883, there are between 23,000 and 25,000. If we include the immediate villages of Central Falls, Valley Falls, Lonsdale and Saylesville, we may safely say we have a population of upward of 35,000.

Within these limits there is a great variety and a vast amount of manufacturing and mechanical industries carried on, and from which the General Government has in years past received large revenues. They paid during the fiscal year ending June 30, 1866, $636,691.98 into the office of the assessors for internal revenue for the first district of Rhode Island.

The revenue from the Pawtucket post-office for the fiscal year ending December 31, 1882, was $12,298 28, which will give you some idea of the business which is transacted here at the present time.

Pawtucket is largely a manufacturing community, and in the extent and variety of its manufactures is not surpassed by any place of equal size in the United States. It contains some of the largest establishments of their kind which are to be found in the country, among whch may be mentioned the Conant Thread Company, manufacturers of the J. & P. Coats spool cotton, with a capital of $3,000,000, and employing over 2,000 operatives, and consuming in the single item of coal 20,000 tons annually.

The W. F. & F. C. Sayles bleacheries, with their manufacturing establishments, employ over 1,500 hands, and their consumption of coal per annum is 15,000 tons.

The Rhode Island Horse Shoe Company, situated in Valley Falls, in the immediate vicinity of this place, is the largest of its kind in the world, and calls for a transportation of 150 tons per day, with a consumption of 12,000 tons of coal per annum.

Without entering further into detail, we would add that not less than $25,000,000 are invested in the different manufacturing industries, all of which could not fail of being benefited by the removal of the obstructions and the improvement of the channel of the Pawtucket River.

The specific improvements needed to put the river in proper condition are the removal of the obstructions at the Railroad and Washington bridges, the straightening, widening, and deepening of the channel, so that when completed it shall have a width of 150 to 200 feet and a depth of 12 feet at low water; also the removal of Seal Rock, near the head of navigation.

Provision has been made by the State government for the removal of the present Washington Bridge and the obstructions under the same, making a depth of water of not less than 15 feet at low water; also providing for five commissioners to be appointed by the State, the town of East Providence, and the city of Providence, to execute the foregoing provision, build a bridge in place of the present Washington Bridge, with a draw having two openings of 80 feet in width, and two years' time has been allowed the commissioners for the completion of the work. Commissioners have already been appointed by the State and the town of East Providence.

All of which is most respectfully submitted.

GEORGE E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee of Pawtucket Business Men's Association.

GEORGE H. ELLIOT,
Lieut. Col. U. S. Engineers.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay, extending from Nayatt Point to the city of Providence. Its length is about 7 miles and its width varies from 1,000 feet to 2 miles. At its head it is joined by the Pawtucket River, extending 5 miles farther, to the town of Pawtucket. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, at one point in the channel—a place called "The Crook," at the junction of the Providence River with the Pawtucket—the available low water depth was but 4½ feet, and Bulkhead Rock, with but 7 to 8 feet of water upon it at low water, with deep water around it, was a dangerous obstruction between Pawtuxet Shoal and Field's Point.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed, during this period, to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Field's Points of the following dimensions in cross-section, viz:

	Feet deep.
300 feet wide	25
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights, such as are in use in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622. A plat of that part of the river which forms the harbor of Providence accompanies my special report on the removal of Green Jacket Shoal, which is appended to this report.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1884.

The amount expended on the present project up to the close of the fiscal year ending June 30th, 1884, including liabilities outstanding at that date, was $125,846.49.

At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed, and the condition of the six straight reaches into which the 25-foot channel, 300 feet wide, is divided, was as follows: The Fox Point Reach had been completed; the Sassafras Point reach had been completed; the Field's Point Reach had been completed; the Pomham Reach had just been commenced; the Pawtuxet reach had been excavated to a width of 200 feet; the Gaspee reach had been excavated to a width of 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. In July, 1884, a survey was made by Assistant Engineer Judson, assisted by a party in the United States schooner Surveyor of a portion of the bottom of the harbor between Fox and Field's points, and of Green Jacket Shoal, and numerous borings were made to discover the character of the material of the bottom.

On the 28th August, 1884, advertisements were issued for dredging, under the provisions of the act of Congress of July 5, 1884, appropriating $85,000 for continuing the improvement. The following proposals were received and were opened September 23, 1884:

NAMES AND ADDRESSES OF BIDDERS.	Price per cubic yard.
	Cents.
Atlantic Dredging Company, Brooklyn, N. Y	12
Henry Du Bois' Sons, New York City	12
P. Sanford Ross, Jersey City, N. J	14
J. Boynton, Newport, R. I., and Lyman Boynton, Boston, Mass	14
National Dredging Company, Wilmington, Del	14 9-10
Moore & Wright, Portland, Me	15
George C. Forbes & Co., Baltimore, Md	15¼

The lowest price having been named by two responsible bidders, the Atlantic Dredging Company and Henry Du Bois' Sons, by an agreement between themselves and with the approval of the Chief of Engineers, the contract was awarded to the Atlantic Dredging Company; contract dated October 17, 1884, to be commenced within thirty days from date of contract, unless otherwise agreed, and completed October 1, 1885.

Work under the above contract was commenced October 23, 1884, and was finished June 6, 1885, during which time there were removed to the dumping ground below Prudence Island 625,073 cubic yards of material in continuing the excavation of that part of the 25-foot channel, 300 feet wide, which is now below Field's Point. Mr. W. C. Simmons, Jr., was local inspector of the work. Mr. C. O. Abell and Mr. Thomas A. Churbuck were also employed as local inspectors during a part of the season of operations. A provision of the act of July 5, 1884, authorized the removal of obstructions at the mouth of the Pawtuxet River, at an expense not exceeding $1,000, to be paid for from the appropriation for Providence River.

A vessel with steam hoisting apparatus and a submarine diver having been employed for this purpose, there were removed from the mouth of the Pawtuxet in September, 1884, forty-nine bowlders of all sizes up to about 40 tons weight each, making a good and safe channel 60 feet wide, with not less than 4 feet of water at mean low water. Mr. A. H. Dickens was local inspector of this work.

On the 20th December, 1884, the following resolution was passed by the Senate of the United States:

IN THE SENATE OF THE UNITED STATES,
December 20, 1884.

Resolved, That the Secretary of War is hereby directed to transmit to the Senate an estimate of the cost of the proposed improvement of the harbor of Providence, Rhode Island, by the removal of Green Jacket Shoal to the depth of 25 feet at mean low water.

Attest: ANSON G. McCOOK,
Secretary.

In compliance with this resolution I was directed to make report. My report and estimate, dated January 10, 1885, were transmitted to Congress and printed as Senate Ex. Doc. No. 42, Forty-eighth Congress, second session, and a copy will be found appended hereto.

AMOUNT EXPENDED AND PROGRESS DURING THE LAST FISCAL YEAR.

The amount expended during the last fiscal year, including liabilities outstanding June 30th, 1885, was $84,834.47. The Pomham Reach and the Pawtuxet Reach were excavated to their full width of 300 feet and full depth of 25 feet. The turn at the upper end of the Pomham Reach was widened to 420 feet, and the turn at the upper end of the Pawtuxet Reach was widened to 440 feet, with the same depth as in the main channel. There has now been excavated a continuous ship-channel 25 feet deep and not less than 300 feet wide from Fox Point, in the city of Providence, to Sabin's Point Light.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

No appropriation having been made at the last session of Congress, no work will be done during the next fiscal year.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

To complete the 25-foot channel 300 feet wide to the deep water of Narragansett Bay there remains the increasing to 300 feet the 200 feet of width already excavated in the lowest (the Gaspee) reach. There also remains for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field's points. It should be observed that the removal of Green Jacket Shoal not having yet been acted on by Congress, the cost of this work, which will be found in the special report on the subject, which is appended to this report, is not included in the "amount (estimated) required for completion of existing project" in the following money statement.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected during the last fiscal year was $201,977.87. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1884, amount available	$2,618 00
Amount appropriated by act approved July 5, 1884	85,000 00
Repayments	186 14
	87,754 14

July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$84,330 65	
July 1, 1885, outstanding liabilities	3 82	
		84,334 47
July 1, 1885, amount available		3,419 67

Amount (estimated) required for completion of existing project	$285,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	$100,000 00

Submitted in compliance with requirements of Section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

PROVIDENCE BOARD OF TRADE, SECRETARY'S OFFICE,
PROVIDENCE, R. I., July 17, 1885.

DEAR SIR: Yours of the 14th came to hand in due season. Yours of the 15th ultimo did not reach me. I now have the pleasure of answering that of the 14th. Commercial statistics at port of Providence for the year 1884 are as follows:

The whole number of arrivals at the port from foreign countries was 59, of which 19 were American, bringing merchandise as follows:

Lumber	feet	3,102,455
Shingles		2,790,500
Laths		6,599,000
Salt	pounds	10,477,679
Scrap-iron	do	1,411,340
Logwood	do	2,035,570
Brimstone	tons	1,129
Molasses	gallons	157,602

Number of coastwise arrivals, 4,209, bringing:

Cotton	bales	142,876
Wool	do	37,941
Flour	barrels	4,349
Grain	bushels	816,172
Coal	tons	766,165

Tonnage of the port, 107 sail vessels, 14,544.47 tons; 34 steam vessels, 19,564.79 tons.

Very respectfully,

F. P. LITTLE,
Secretary.

Lieut. Col. GEO. H. ELLIOT.

LETTER OF COLLECTOR OF CUSTOMS AT PROVIDENCE, RHODE ISLAND.

CUSTOM-HOUSE, PROVIDENCE,
Collector's Office, July 1, 1885.

SIR: In compliance with your request I enclose herewith statistics of the commerce, &c., of this port during the year 1884.

Very respectfully,

CYRUS HARRIS,
Collector.

Col. GEO. H. ELLIOT.

[Inclosure.]

PROVIDENCE, June 30, 1885.

DEAR SIR: In compliance with your request I submit the following statement, giving, as far as time and available data would allow, such information concerning the commerce of this port for the year 1884 as was called for in your letter from Lieutenant-Colonel Elliot, dated Newport, June 15, 1885.

The custom-house records show that the aggregate number of vessels that arrived at the port of Providence during the year 1884 was 5,974, making the total of vessels that arrived and sailed, 11,948, classified as follows: steamers, 2,551; barks and brigs, 35; schooners, 2,277; barges, 763; sloops, 75, and 273 steam-tugs used in towing the coal, iron, and lumber barges to and from this port.

	Tons.
The net registered tonnage of the above arrivals was	1,953,573
Of vessels sailed	1,953,573
Total tonnage arrived and sailed	3,907,146

Many of the steamers, barks, and large three and four masted schooners of the above arrivals were deep-draught vessels, drawing from 15 to 20, and some of them 22, feet.

The following staple articles of merchandise, brought to this port by the above vessels during the year 1884, were:

Cotton	bales	150,344
Wool	do	28,211
Flour	barrels	5,042
Grain	bushels	813,172
Coal	tons	767,831
Lumber	do	50,000
Iron	do	20,000
Brick	do	15,000
Lime	do	10,000

There are several excursion steamers and other vessels plying between this port and other landings on Narragansett Bay, within the district of Providence, that are not included in the above statement, but would considerably increase the number of arrivals and aggregate tonnage.

OPERATIONS DURING THE LAST FISCAL YEAR.

Under the authority of the Act of Congress. of July 5, 1884, appropriating $50,000.00 for the work, advertisements were issued for dredging a channel 100 feet wide and 12 feet deep at mean low water, commencing at the deep water above Red Bridge and extending as far up the river as the available funds would pay for, and the specifications for the work were printed and distributed. The following proposals were received and were opened September 23, 1884:

NAMES AND ADDRESSES OF BIDDERS.	Price per cubic yard.
	Cents.
Elijah Brainard and Thomas H. Benton, New York City	21
Atlantic Dredging Company, Brooklyn, N Y	21⅛
P. Sanford Ross, Jersey City, N. J	21¾
National Dredging Company, Wilmington, Del	21 9-10
George C. Forbes & Co., Baltimore, Md	23
Moore & Wright, Portland, Me	24
J. Boynton, Newport, R. I., and Lyman Boynton, Boston, Mass	26
John McDermott, Cohoes, N. Y,	26
Richard M. Payn, Albany, N. Y	26⅞

With the approval of the Chief of Engineers, the contract was awarded to Mr. Elijah Brainard and Mr. Thomas H. Benton, the lowest bidders; contract dated October 16, 1884, to be commenced within ten days after removal of Washington Bridge, and completed within nine months after date of commencement. There being no nearer available dumping place for the dredged material than below Prudence Island, in Narragansett Bay, and the old bridge over the Pawtucket below the work, known as the Washington Bridge, forming an obstruction to the passage of tows of loaded scows that was difficult and dangerous, the specifications for the work did not require it to commence before ten days after the removal of this bridge, which had been provided for by a law of the State of Rhode Island. The work of removal commenced in June, 1884, but at the end of the fiscal year it had not been completed, and the work on the new channel had not been commenced.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

It is expected that the removal of Washington Bridge will be completed and that the work under the current contract will be commenced within a few weeks, and that the contract will be completed in the time agreed on, viz: within nine months from the removal of the bridge, or before the first of May, 1886, exhausting the appropriation.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $201,977.87. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort at Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1884, amount available	$529 58
Amount appropriated by act approved July 5, 1884	50,000 00
	50,529 58
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,242 06
July 1, 1885, amount available	49,287 52
Amount (estimated) required for completion of existing project	882 478 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	75,000 00

Submitted in compliance with requirements of Section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

PAWTUCKET, July 1, 1885.

DEAR SIR: I am in receipt of your communication of June 15. In reply, it is my opinion that the statistics furnished last year, of which you undoubtedly have a copy, are sufficiently accurate for the purpose named. I believe, owing to the great depression in business, that the showing would not be materially changed.

Respectfully yours,

GEO. E. NEWELL.

Lieut. Col. GEORGE H. ELLIOT,
Engineers U. S. A.

COMMUNICATIONS FROM THE PAWTUCKET, RHODE ISLAND, BUSINESS MEN'S ASSOCIATION.

1

PAWTUCKET, R. I., June 14, 1883.

DEAR SIR: Your favor of May 22, addressed to the Pawtucket Business Men's Association, was duly received, and the undersigned, a committee appointed by said association to obtain the information desired, most respectfully submit the following statistics of the commerce in Pawtucket River for the year 1882:

In consideration of these facts and the comparative economy of making the whole depth in one contract, it will doubtless be advisable to dredge the shoal at once to the depth of 25 feet at mean low water.

Assuming that the city will take care of the space between the harbor lines and lines drawn parallel and distant 200 feet from them, the survey above referred to shows that the amount of material to be removed is 851,108 cubic yards. Our borings covered every part of the shoal and we found that it is almost entirely composed of mud. My current contract for dredging similar material in the 25-foot channel in Providence River is 12 cents per cubic yard, and although this is almost a minimum price for such work, I think it safe to estimate that the shoal can be removed at the same rate, or, allowing 10 per cent. for contingencies, at a total cost of $112,346.25.

The collector of customs at Providence reports 17,104 arrivals and departures of vessels during the year 1888, with an estimated total tonnage of 4,522,768 tons.

In concluding this report it may be proper for me to remark that when this shoal is removed the harbor of Providence will be one of the finest in the country, whether in respect of its capacity for deep-draught vessels or its security or the safety of its approaches or its distance inside the general coast line, which gives it an especial advantage by reason of the comparatively low rates of water transportation.

Very respectfully, your obedient servant,

GEORGE H. ELLIOT,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers U. S. A.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is on the main entrance to Narragansett Bay. It is one of the most important harbors on the coast, providing a safe roadstead and anchorage. Newport itself is upon an inner harbor, separated from Narragansett Bay by Goat Island and a breakwater which extends northerly from the island about 1,400 feet. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project, and its subsequent modifications, under which work is now carried on, are substantially as follows: Deepening the southern entrance information respecting the commerce and manufactures that would be benefited by further improvement of the Pawtucket River.

Pawtucket, situated at the head of navigation, 4 miles above Providence, becomes a distributing point for merchandise to supply an extensive inland trade. Among the towns which draw more or less of their supplies from Pawtucket may be mentioned East Providence, Seekonk, Rehoboth, Attleboro', Mansfield, Wrentham, Franklin, Cumberland, Lincoln, Smithfield, and North Providence.

Pawtucket naturally commands the trade of the territory for half the distance to Boston and entire valley of the Blackstone River. One hundred and thirty trains over Boston and Providence, the Providence and Worcester, and the New York and New England railroads pass through this place daily. Its convenience for transportation by rail, the facility with which its citizens can reach all the large centres of business, together with its manufacturing and mechanical industries, have attracted people from various parts of the world to settle here.

The growth of Pawtucket has been rapidly increasing. In 1865 there were 5,000 inhabitants; at the present time, 1883, there are between 23,000 and 25,000. If we include the immediate villages of Central Falls, Valley Falls, Lonsdale and Saylesville, we may safely say we have a population of upward of 35,000.

Within these limits there is a great variety and a vast amount of manufacturing and mechanical industries carried on, and from which the General Government has in years past received large revenues. They paid during the fiscal year ending June 30, 1866, $636,691.98 into the office of the assessors for internal revenue for the first district of Rhode Island.

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Without entering further into detail, we would add that not less than $25,000,000 are invested in the different manufacturing industries, all of which could not fail of being benefited by the removal of the obstructions and the improvement of the channel of the Pawtucket River.

The specific improvements needed to put the river in proper condition are the removal of the obstructions at the Railroad and Washington bridges, the straightening, widening, and deepening of the channel, so that when completed it shall have a width of 150 to 200 feet and a depth of 12 feet at low water; also the removal of Seal Rock, near the head of navigation.

Provision has been made by the State government for the removal of the present Washington Bridge and the obstructions under the same, making a depth of water of not less than 15 feet at low water; also providing for five commissioners to be appointed by the State, the town of East Providence, and the city of Providence, to execute the foregoing provision, build a bridge in place of the present Washington Bridge, with a draw having two openings of 80 feet in width, and two years' time has been allowed the commissioners for the completion of the work. Commissioners have already been appointed by the State and the town of East Providence.

All of which is most respectfully submitted.

GEORGE E. NEWELL,
GEO. P. GRANT,
HENRY F. JENKS,
Committee of Pawtucket Business Men's Association.

GEORGE H. ELLIOT,
Lieut. Col. U. S. Engineers.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay, extending from Nayatt Point to the city of Providence. Its length is about 7 miles and its width varies from 1,000 feet to 2 miles. At its head it is joined by the Pawtucket River, extending 5 miles farther, to the town of Pawtucket. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

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PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed, during this period, to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Field's Points of the following dimensions in cross-section, viz:

	Feet deep.
300 feet wide	25
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights, such as are in use in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622. A plat of that part of the river which forms the harbor of Providence accompanies my special report on the removal of Green Jacket Shoal, which is appended to this report.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1884.

The amount expended on the present project up to the close of the fiscal year ending June 30th, 1884, including liabilities outstanding at that date, was $125,846.49.

At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed, and the condition of the six straight reaches into which the 25-foot channel, 300 feet wide, is divided, was as follows: The Fox Point Reach had been completed; the Sassafras Point reach had been completed; the Field's Point Reach had been completed; the Pomham Reach had just been commenced; the Pawtuxet reach had been excavated to a width of 200 feet; the Gaspee reach had been excavated to a width of 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. In July, 1884, a survey was made by Assistant Engineer Judson, assisted by a party in the United States schooner Surveyor of a portion of the bottom of the harbor between Fox and Field's points, and of Green Jacket Shoal, and numerous borings were made to discover the character of the material of the bottom.

On the 28th August, 1884, advertisements were issued for dredging, under the provisions of the act of Congress of July 5, 1884, appropriating $85,000 for con-

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, NEWPORT, R. I.
COLLECTOR'S OFFICE, July 15, 1885.

SIR: I have the honor to acknowledge the receipt of your letters of the 15th ultimo. During the year ending June 30, 1885, about five thousand vessels of all classes have arrived at this port, either for a harbor or to discharge cargoes; this includes steam and sail vessels engaged in coasting trade, fisheries and yachting. During the year ending June 30, 1885, twelve vessels have arrived at this port from foreign ports and discharged their cargoes; nine vessels have cleared from this port for foreign ports. The cargoes from foreign ports consisted of—

Spruce boards	feet..	763,359
Spruce laths	packages..	287,800
Hemlock boards	feet..	366,438

During the same year there has been landed at this port, say—

Coal	tons..	42,000
Shingles		3,750,000
Laths		8,000,000
Lime	barrels..	12,000
Cement	do....	5,700
Bricks		4,000,000
Lumber	feet..	9,500,000

The amount of revenue collected in this district from duties on imports, tonnage tax, Marine Hospital tax, inspection of steam-vessels, and miscellaneous receipts during the year ending June 30, 1885, was $3,554.72; the decrease from previous years being on account of the law abolishing Marine Hospital tax, fees on certain work, and reduction of steamboat-inspection fees, and tonnage tax. There are 133 vessels owned in and hailing from this port, viz: 118 sail and 15 steam. The gross tonnage of the 133 vessels is 5,596.76. The net tonnage of the 133 vessels is 4,557.75. The tonnage of the largest vessel is 708.69 gross; 673.26 net. The tonnage of the smallest vessel is 3.75 gross; 2.17 net. The largest vessel draws 13 feet when loaded.

Trusting that statistics above referred to are sufficient for your purposes,

I remain, respectfully,

J. H. COZZENS,
Collector.

Lieut. Col. G. H. ELLIOT.

LETTER OF THE SUPERVISOR OF THE OLD COLONY STEAMBOAT COMPANY.

OLD COLONY STEAMBOAT COMPANY,
NEWPORT, R. I., June 26, 1885.

DEAR SIR: Your letter of the 16th instant received. In reply I respectfully submit the amount of merchandise carried by the steamers of this line during the year ending May 31, 1885, to be 245,000 tons, and the number of passengers 260,000.

Yours truly,

GEORGE PEIRCE,
Supervisor.

Lieut. Col. GEORGE H. ELLIOT.

LETTER OF THE SUPERINTENDENT OF THE NEWPORT AND WICKFORD RAILROAD AND STEAMBOAT COMPANY.

Superintendent's Office,
Newport and Wickford Railroad and Steamboat Company,

NEWPORT, R. I., June 18, 1885.

SIR: Your letter of June 16 duly received and contents noted, and I would say in reply that the number of passengers carried by this line from August 31, 1883, to September 1, 1884, was 66,074, and the total amount of freight was 1,690 tons.

Yours truly,

THEO. WARREN,
Superintendent.

Colonel ELLIOT,
Engineer Office, U. S. A.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles south of the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden. The mean rise and fall of the tide is about 3 feet.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor for the protection of small vessels and an exterior harbor for large ones. The former was to be about 250 to 300 feet in area, and inclosed, with the exception of an opening 60 feet wide in the clear on the sea side, by timber crib work filled with stones and resting on a riprap foundation. The exterior harbor was to be formed by a riprap breakwater designed to intercept the waves from the eastward, and the beds of both harbors to be cleared of bowlders. The next project (1881) was to build a masonry wall on the east side of the inner harbor in lieu of the old crib-work on that side, which was in danger of breaking down in storms, and also to protect the cliff which lies to the eastward of the harbor, the material of which was carried by the current into the harbor, decreasing its depth. The last project for the work, the one under which we are now working, provides for filling the gap in the main breakwater under the provisions of the act of Congress of July 5, 1884, appropriating $15,000 for "improving the breakwater." This gap, 200 feet in length, and 1,400 feet from the shore, had been left for the convenience of vessels getting in and out of the harbor, but it was found to let in too much of the sea in stormy weather, interfering with the usefulness of the harbor. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, will be found with the special report on the enlargement of the inner harbor which accompanies this report.

AMOUNT EXPENDED, AND RESULTS, TO JUNE 30, 1884.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. In 1883 a strong jetty was built out from the cliff to the eastward of the inner harbor, and a masonry wall was constructed on the inside of the crib-work forming the eastern side of the inner harbor for the purposes before mentioned.

The total expenditures up to June 30, 1884, including liabilities outstanding at that date, were $306,859.98.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. In August, 1884, a survey of the bottom of the inner and outer harbors was made by Assistant Engineer Judson, assisted by a party in the United States schooner Surveyor, and at the same time the wharf in the inner harbor, which had been repaired in 1883 by means of an appropriation which was made in 1882, was again repaired, as far as the funds available for the purpose would allow. It is proper to be remarked in this connection that this wharf is so thoroughly decayed that it is past any useful repair, and should be replaced by a new structure. The supplies for the light houses are landed here, and all the passengers (many thousand annually) and all the goods to and from the island arrive at and depart from it, except that in summer months an excursion steamer from the mainland uses for its passengers a small private wharf in the outer harbor, but this wharf cannot be used in winter on account of the exposure of the outer harbor. As the case now stands, the public considers the wharf a Government wharf, and that it has no right to do anything to it, and if it is not to be renewed at Government expense by means of an appropriation made for the purpose—it will require about $2,500—provision should be made for turning it over to the authorities of the town of New Shoreham (the corporate name of Block Island) for public use and maintenance.

On the 6th of October, 1884, advertisements were issued for riprap granite for filling the gap under the provisions of the act of Congress of July 5, 1884, appropriating $15,000 for improving the breakwater. The following proposals were received and were opened on the 28th of the same month:

NAMES AND ADDRESSES OF BIDDERS.	Price per ton of 2,240 pounds.
James Scully, Groton, Conn.	$1 65
Isaac A. Sylvester, Newton Centre, Mass	1 67

With the approval of the Chief of Engineers, the contract was awarded to Mr. James Scully, the lowest bidder; contract dated November 15, 1884, to be commenced within one month after signing of contract, unless otherwise agreed, and completed August 31, 1885.

Work under the above contract was commenced March 19, 1885, and at the end of the fiscal year is still in progress. The amount of riprap stone deposited in the gap during the year was 5,795 tons. Mr. Andrew R. Elliot is the local inspector of the work.

On the 8th December, 1884, the following resolution was passed by the Senate of the United States:

IN THE SENATE OF THE UNITED STATES,
December 8, 1884.

Resolved, That the Secretary of War be, and he hereby is, directed to communicate to the Senate, without unnecessary delay, whether there exists a public necessity for the enlargement of the basin or harbor inside the breakwater at Block Island, Rhode Island, for the proper accommodation of the shipping seeking refuge at that place; and, if so, to what extent should such enlargement be made, and what would be the probable cost thereof.

Attest:

ANSON G. MCCOOK,
Secretary.

In compliance with the above resolution I was directed to make report. My report and estimate, dated December 30, 1884, were transmitted to Congress and printed as Senate Ex. Doc. No. 27, Forty-eighth Congress, second session, and a copy will be found appended hereto.

AMOUNT EXPENDED, AND PROGRESS, DURING THE LAST FISCAL YEAR.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1885, was $12,065.11, and the result was the filling of the whole length of the gap nearly up to mean low water, but not to the full width of the breakwater at that level. The width of the filling at the top on June 30, 1885, was about 10 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

With the remainder of the funds available for the purpose, it is proposed to carry the filling of the gap in the breakwater as high as they will admit. It is expected that the current contract will be completed, and the appropriation of July 5, 1884, will be exhausted, August 31, 1885. No appropriation having been made for this work at the last session of Congress, no other work will be done during the next fiscal year.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

The work which will be required to be done to complete the present project after the completion of the current contract will be the filling of the gap to its full height of 6 feet above mean high water and its full width at top of 25 feet.

It should be remarked that the enlargement of the inner harbor or basin not having yet been acted upon by Congress, the cost of this work, which will be found in the special report on the subject which is appended to this report, is not included in the "amount (estimated) required for completion of existing project" in the following money statement:

Block Island is in the Newport collection district, and Newport is the nearest port of entry. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge for coasting vessels. There are four lights on the island, the north and south lights and the breakwater lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1884, amount available		$3,140 02
Amount appropriated by act approved July 5, 1884		15,000 00
		18,140 02
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,849 29	
July 1, 1885, outstanding liabilities	4,215 82	
		12,065 11
July 1, 1885, amount available		6,074 91
Amount (estimated) required for completion of existing project		24,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		24,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

SPECIAL REPORT ON ENLARGEMENT OF THE BASIN OR HARBOR INSIDE THE BREAKWATER AT BLOCK ISLAND, RHODE ISLAND.

ENGINEER OFFICE, UNITED STATES ARMY,
NEWPORT, R. I., December 30, 1884.

GENERAL: I have the honor to acknowledge the receipt of a copy of the following resolution of the Senate of the United States:

IN THE SENATE OF THE UNITED STATES,
December 8, 1884.

Resolved, That the Secretary of War be, and he hereby is, directed to communicate to the Senate, without unnecessary delay, whether there exists a public necessity for the enlargement of the basin or harbor inside the breakwater at Block Island, R. I., for the proper accommodation of the shipping seeking refuge at that place, and, if so, to what extent should such enlargement be made, and what would be the probable cost thereof.

Attest:

ANSON G. MCCOOK,
Secretary.

In compliance with the directions contained in an indorsement on the above resolution, I beg leave to submit the following report:

The harbor of refuge at Block Island, which is entirely an artificial harbor, is at the southern end of the curve which forms the eastern side of the island. Before its construction Block Island had no harbor. The only vessels used were open boats, which on the approach of storms were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

The works consisted of a main breakwater, which extends northerly from the shore, a distance of about 1,900 feet, forming the outer harbor, and the inner harbor or basin referred to in the resolution of the Senate.

The inner harbor lies in the western angle between the breakwater and the shore. It is about 300 feet by 250 feet in area and has an opening about 80 feet wide (60 feet in the clear), on the north side, through which vessels pass to and from the outer harbor.

It was first dredged to a depth of 7 feet at mean low water. Afterwards it was dredged to a depth of 9 feet, and the bottom of a large part of the outer harbor was cleared of bowlders.

The main breakwater, except for a distance of about 300 feet from the shore, where it forms the eastern side of the inner harbor, is constructed of riprap granite. It is 35 feet wide at the top, which is 6 feet above mean high water. The inner slope is 1 on 1 and the outer slope is 1 on 2.

The eastern, northern, and western sides of the inner harbor are of crib-work constructed (in 1871–'72) of spruce timber, resting at about the level of low water, on a riprap foundation, and filled with stones gathered on the island.

The crib-work on the eastern side, which is most exposed to the force of the waves, became so much decayed that an interior wall of masonry was constructed during the last year to protect the inner harbor when the crib-work on that side is carried away by the sea.

The crib-work on the two other water sides of the inner harbor is also very much decayed, and will soon be liable to destruction in heavy storms.

A plat exhibiting the bottom of the outer harbor as it was found by the survey of 1878, and also by the survey which I caused to be made last August, shows that there was much shoaling—8 feet in some places—between the times of the two surveys.

The material used for this shoaling comes from the high cliffs at the southward and eastward of the harbor, which are constantly being undermined by the sea, and also from the shore, which extends from the harbor to the northward and westward.

The former material is carried along outside the main breakwater, a part of it passing through the interstices of the riprap forming a parallel bank inside, which does not encroach much upon the anchorage.

Another portion passes through the gap in the main breakwater, and is doubtless afterwards brought farther into the outer harbor in northerly storms, causing a general shoaling of the harbor.

After the closing of the gap, which is to be done by means of the appropriation of July 5, 1884, some material will probably pass around the outer end of the main breakwater and be carried into the outer harbor as before.

The quantity of material which comes from the shore to the northward and westward of the harbor is very large, as is shown by the great amount of filling in the angle between this shore and the harbor works.

UTILITY OF THE INNER HARBOR.

The eastern shore of Block Island, on which the harbor of refuge is situated, is exposed to the full force of the waves of the Atlantic. In northerly storms especially, small vessels cannot lie with safety in the outer harbor, and even in northeasterly and easterly storms the swell which makes round the extremity of the main breakwater is so heavy that none except large vessels will remain outside, unless for want of room they cannot get into the inner harbor -which although made for the temporary purpose of sheltering the vessels that carried stone from the mainland for the main breakwater in the earlier periods of its construction, has proved one of the most beneficial works in my district. At night, especially in bad weather, it is always filled to its full capacity.

On a recent visit to Block Island I counted fifty-nine fishing and other vessels crowded into this little area, and larger numbers would have availed themselves of the complete shelter which it affords, except for the want of room.

Appended to this report, I send a copy of a letter containing the statistics of the use of the inner harbor during the last year, which have kindly been furnished by the Hon. Nicholas Ball, a prominent citizen of Block Island, at my request.

These statistics confirm the judgment derived from my own observation, that the size of this excellent refuge is entirely inadequate to the requirements of local and coasting vessels, and that it would not be good policy to replace by masonry walls the decayed crib-work, retaining the present size of the inner harbor.

I intended to submit these views to the Chief of Engineers in my next annual report, and I am gratified at this earlier opportunity, furnished by the Senate resolution, of stating that, in my judgment, the enlargement of the inner harbor is a public necessity, and of submitting the following plan for it:

PROPOSED ENLARGEMENT OF THE INNER HARBOR.

From the shore west of the inner harbor, and at a distance of about 1,000 feet from it (1,300 feet from the prolongation of the line of the main breakwater), there is an old jetty which was constructed upon a bowlder reef which projected from the shore at this point and extends out to about 800 feet from the high-water line. This jetty, which was built of rounded bowlders found on the island, had not much stability, and has become much flattened down by the sea.

I propose to build up on this jetty, and to extend it about 200 feet on a line parallel to and distant about 950 feet from the main breakwater; thence the western part of the proposed inner breakwater follows an arc of 90 degrees with a radius of 150 feet, and connects with the northern part which is on a line running at right angles with the main breakwater, and intersecting it at a point about 650 feet from the outside of the crib-work forming the north side of the present inner harbor, or about 950 feet from the Government wharf on the south side of this harbor.

The inner breakwater is to be constructed of granite riprap 4 feet wide on the top, which is to be 5 feet above mean high water. The western part to have side slopes of 1 on 1, the northern part to have a slope of 1 on 1 on the inside, and a slope of 1 on 1½ on the outside. The shore end of the western part above the low-water line is to be constructed of crib-work filled with stone.

At a distance of 150 feet from the main breakwater, or, more exactly, 150 feet from the 6-foot curve of the submerged bank on the inside of this breakwater, I propose to leave in the inner breakwater an opening, on each side of which there is to be constructed a pier-head of dry masonry, protected by fender piles in the usual manner, leaving the opening 100 feet wide in the clear.

The northern part of the inner breakwater, which is on the most exposed side, should be built first. This would allow us to remove the crib-work which forms the northern side and a part of the western side of the present inner harbor, and to use the stone filling and foundation—say 4000 tons—on the western side of the enlarged harbor.

The area of the present inner harbor is about 1¾ acres. The area of the proposed harbor, inclosed between the low-water line on the shore and the inner breakwater, is about 18¼ acres. About 5 acres are inclosed within the curve of 9 feet at mean-low water, 9½ acres within the 6-foot curve, and 15 acres within the 3-foot curve.

Experience has shown that the depth gained by dredging in the present inner harbor is permanent, and it will doubtless be found that the shoaling of that part of the outer harbor which it is proposed to include within the new works will be stopped, since the littoral sands now brought in by the waves from the westward, and the sands which are now brought in through the gap in the main breakwater, and which, when it is closed, may be brought in around its extremity, will be arrested; the former by the western part and the latter by the northern part of the proposed inner breakwater.

It is probable that, for the purpose of sheltering the larger class of vessels in the outer harbor in northerly and northeasterly storms, and of quieting the water in that harbor in all storms from the eastward, it may be found necessary at some time in the future to extend the main breakwater in a westerly direction 1,000 or 1,200 feet, or to such distance as may be desired, leaving an opening between it and the present head of the breakwater.

The area of the enlarged inner harbor for small vessels (nearly all of the vessels which now use the harbor of refuge at Block Island are of this class) is not as large as I would have proposed, except that I do not wish to encroach so much on the area of the outer harbor as to impair its usefulness for large vessels, the number of which seeking refuge at Block Island is likely to increase, especially in case the main breakwater is extended as above mentioned.

If deemed desirable, however, when we come to the construction we can make the northern part of the inner breakwater on a line 100 or 200 feet further north with but little increase of expense.

The Government wharf, which occupies the land side of the present inner harbor, is the only wharf at Block Island, except a private wharf which was built some years since outside the inner harbor and on the inside of the main breakwater, by permission of the Secretary of War. The latter wharf is used only in summer, and by steamers which carry visitors and excursionists from and to the mainland. The Government wharf is always overcrowded with the traffic of the island. All the freight carried to and from the island is brought here, and at it are landed the United States mails and the supplies for the four light-houses, which are on the island, and the steam fog signal.

The enlargement of the inner harbor will allow additional private wharves to be built within it, and thus relieve the Government wharf, but the building of such wharves should only be by authority of the Secretary of War and under such conditions as may be prescribed by him.

In the following estimate of the cost of the proposed enlargement I have not included any dredging of the area proposed to be included within the inner harbor. None will be necessary in the first instance, and when it becomes so it can be done gradually and as the wants of the harbor may require. As before suggested, any additional depth which may be gained by dredging in the enlarged nner harbor will be permanent.

ESTIMATED COST OF THE PROPOSED ENLARGEMENT.

21,120 tons of riprap granite, at $1.65 per ton........................	$34,848
Removing 4,000 tons of stone from the cribs which form the sides of the present inner harbor to the proposed inner breakwater, at 50 cts. per ton..	2,000

Breaking up and removing the old cribs	200
Building new crib-work above the low-water line at the inner end of the western part of the proposed inner breakwater	520
334 cubic yards of dry stone masonry in the pier-heads at entrance to the new harbor, at $11 per cubic yard	3,674
Fenders and dolphins at entrance	748
	41,990
Add 10 per cent. for contingencies	4,199
Total estimated cost	$46,189

Very respectfully, your obedient servant,

GEORGE H. ELLIOT,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF HON. NICHOLAS BALL.

BLOCK ISLAND, R. I., December 16, 1884.

MY DEAR SIR: Yours of the 13th, in which you ask for the statistics of the use by vessels of the inner harbor or basin during the last few years, and especially during the last year, was received on Saturday,

In reply would inform you that on its receipt I at once sought an interview with Mr. Uriah Dodge, who keeps the range-lights here, and also with my son, C. C. Ball, who keeps the store here, both of whom have more or less to do with the boats and vessels which frequent the harbor.

There is no record kept by any one of the arrival and departure of vessels, hence I could gather nothing authentic, more than I have got together in a report which I inclose, which, in my opinion, is not far out of the way, and which I hope and trust will answer your purposes. The report may be considered as that of the past year; the three previous years on an average. say 20 per cent. less.

Mr. Dodge, the light-house keeper, says that thirty-five boats and small vessels fill the basin full enough, especially in bad weather. He further says:

The general stock of swordfish here last season, at a rough estimate, is about	$12,000
Stock of mackerel	10,000
Stock of codfish	18,000
Stock of bluefish	8,000
Stock of flounders	800
Stock of lobsters	5,000
Fish caught in two "pounds,"	11,500
Total	$65,300

I think the estimate is too small by about 12½ per cent. Should you want any information further please let me know and I will do the best I can for you.

Yours, respectfully,

NICHOLAS BALL.

Lieut. Col. GEO H. ELLIOT, U. S. A.

P. S.—The mackerel fleet of 200 sail, which is spoken of in the report, I should say would average the past six years 100 sail that came into the outer bay for a harbor, the crews coming on shore in their boats to obtain water and supplies. Several years ago the fleet fished in these waters for two months and harbored around the island, one side or the other, nearly every night.

N. B.

STATISTICS OF THE USE BY VESSELS OF THE INNER HARBOR AT BLOCK ISLAND, RHODE ISLAND.

Names of home vessels engaged in the fishing and freighting business.—Steamers: Geo. W. Danielson and Ocean View. *Schooners:* N. F. Dixon, Rose Brothers, Hattie Rebecca, Annie Godfrey, Laura Louise, Mystery, Laura E. Garnage, and about fifty others, including sloops, &c.

Vessels from New London, Connecticut.—Schooners: Emma, Chapel Brothers, Maria, White Cloud, Hattie Douglass, Robert Gray, Nelson, Woolsey, Alnoma, C. M. Harris, Laurel, Conquest, Horizon, James Woolsey, Kate Church, Belle of the Bay, Scotia; *Sloops:* Thorn, S. R. Packer, Favorite, Nettie Foote, Superior, Fashion, J. G. Freeman, Sharon, and about fifteen or twenty others whose names are not at hand.

Vessels from Noank, Connecticut.—Schooners: Mary Hoxie, Emma, Jas. Potter, Mary Potter, Redwing, Phebe, Annie Fowler, Ada, Belle, Ira and Abby, Willey; steamer Eva; *Sloops:* S. B. Miller, Wildwood, Eagle, Millie, Isabella, Ella May, Tiny B., and about ten or fifteen others whose names are not at hand.

Vessels from New Bedford, Massachusetts.—Schooners: Quilip, Gracie Phillips, Bella, Emma Clifton, Wasp, J. W. Flanders, Maria, Black Swan, Spy, Yankee Bride, Village Belle, Penekese. *Sloops:* Transit, Frank Clarke, Carrie, Ida, Wm. Young, and about ten or fifteen others whose names are not at hand.

In addition to the above there are about 225 mackerel and other fishing vessels from Cape Cod and the east; 50 menhaden steamers from different places, about 20 vessels from Newport, R. I., during the winter, quite a number from New York, and there are annually probably thirty cargoes from larger vessels, with coal, wood, lumber, bricks, &c., besides the numerous yachts and other craft which frequent here in the summer months, Government vessels with supplies, &c. The greater part of them are compelled to anchor in the outer harbor in consequence of the overcrowded basin. Vessels with cargoes are greatly inconvenienced, and often are compelled to wait for vacancies, and even then collisions are imminent, to the great disadvantage of all concerned.

IMPROVEMENT OF LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

Little Narragansett Bay lies on the north side of the eastern entrance from the ocean into Long Island Sound, and is inclosed on the southern and eastern sides by a long and narrow tongue of land, extending from the mainland at Watch Hill, first westerly and then northerly to the entrance to the bay, which is from the outer harbor of Stonington. Pawcatuck River, upon which is situated the flourishing commercial and manufacturing town of Westerly, R. I., empties into the eastern side of the bay, and has been improved by the United States. The mean rise and fall of the tide is 2.63 feet.

ORIGINAL CONDITION

The navigable draught of water through the bay before improvement was about 4½ feet at mean low water, and this depth limited the navigation of Pawcatuck River.

PLAN OF IMPROVEMENT.

The project of 1878 for the improvement of the bay provided for a channel 200 feet wide and 7½ feet deep at mean low water, extending from the entrance to the bay to the mouth of the Pawcatuck, and the removal of the bowlders which then obstructed navigation, and any others which the excavation of the channel might develop. Subsequently it was determined to clear away some large bowlders which interfered with steamboat navigation between this channel and Watch Hill, an important place of summer resort. The estimated cost of the improvement was $51,000.

A plat of Little Narragansett Bay, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1879, page 314.

AMOUNT EXPENDED AND RESULTS.

The project was completed in the fiscal year 1883–'84. The main channel as projected was excavated to its full width and depth, and the channel to Watch Hill was increased from 90 to 165 feet in width by the removal of bowlders. Vessels drawing ten feet of water can now reach the mouth of the Pawcatuck River at high water, but the full benefit of the improvement cannot be utilized until further deepening of that river to enable vessels of the same draught to reach the important manufacturing town of Westerly. A report on this subject was submitted September 19, 1884, in compliance with the river and harbor act of Congress of July 5, 1884, which was printed as House Ex. Doc. No. 183, Forty-eighth Congress, second session, a copy of which will be found in Appendix C 18.

The remainder of the last appropriation for this work is reserved for comparative surveys of Sandy Point, at the entrance to the bay, which seems to be affected by the construction of the breakwater in Stonington Harbor, and for range-marks on Pawcatuck Point to guide through the new channel. The total cost of the completed improvement was $85,856.96.

Little Narragansett Bay is in the collection district of Providence and Stonington, the dividing line passing through the bay. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $201,977.87; Stonington, $1,511.76. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1884, amount available	$143 04
July 1, 1885, amount available	143 04

Sing 1010.2

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, A. D. 1887.

PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1887.

State of Rhode Island and Providence Plantations.

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1887.

HARVARD COLLEGE
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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.

The Board of Harbor Commissioners respectfully submit their Eleventh Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed Henry C. Bradford, of Providence, whose term of service as Harbor Commissioner expired in June, for a further term of three years.

HARBOR LINES.

Upon petition of B. W. Evans and others representing the ownership of a large part of the property on the easterly side of Providence river from Kettle Point to Bullock's Point, praying that a harbor line be "established from the point where said harbor line is already established to and around the lower end of Bullock's Point" the Commissioners ordered the preparation of plans for establishing a harbor line from Kettle Point to Nayatt Point, and a public hearing was advertised according to law. After two public hearings, and a thorough consideration of the subject at several meetings, the Commissioners designed a line from Kettle Point to a point five hundred feet due south from Nayatt Point light-house, which will be reported to the Governor and Senate.

The Commissioners believe that there is urgent need of action by the General Assembly in relation to encroachments on the Pawcatuck river at Westerly. It is desirable, if not necessary, that action be taken at the same time by the State of Connecticut in harmony with the action of Rhode Island. The establishment of harbor lines on both sides of the river is desirable.

ENCROACHMENTS AND DUMPING.

Frequent occasion has arisen during the year for interference by the Commissioners to prevent encroachments and injurious dumping in tide waters. Permits for limited amounts of local dumping have been given, under restrictions, in a few cases.

In one case the Commissioners prohibited the dumping of material in the Blackstone river, beyond the limits of tide water, on the ground that ordinary freshets would carry forward this material to become an obstruction in tide water. Probably a fuller definition of the powers of the Commissioners to act in such cases would be useful.

The need for supervision to prevent the dumping of ashes from steamers continues.

A building partially erected over tide water beyond the harbor line at Pawtuxet has not yet been removed although action to that end has been taken by the Commissioners.

Walls have been built, under requirement of the Commissioners, to prevent washing of banks into the stream at Pawtucket.

PAWTUCKET RIVER.

Great improvement has been made in the channel of the Pawtucket river at India Point, but the abutment of the old Washington bridge, on the west side, was not wholly removed, with the rest of the bridge, by the Seekonk Bridge Commissioners and it, with its adjoining walls and filling, stands as a considerable obstruction beyond the harbor line. Further action by the General Assembly seems desirable in regard to the removal of this obstruction.

LICENSES, ETC.

Licenses have been issued as follows :

No. 66, June 16, to the Fall River and Providence Steamboat Company to repair their wharf near South Water street in Providence.

No. 67, June 16, to Smith Grant & Co., to repair and restore the wharf on the west side of Pawtucket river near Ship street, in the city of Pawtucket.

No. 68, December 15, to the Providence Yacht Club to erect a Club House on Big Rock, off Pawtuxet Neck in Providence river, also for a bridge from the Rock to said Neck.

Assent has been given as follows :

1. January 27, to the New York, Providence and Boston Railroad Company to drive piles and erect a temporary bridge at the entrance to Apponaug Cove in Warwick.
2. April 28, to Rooks & Havens to build a wharf at the foot of Atlantic avenue in Warwick.
3. May 19, to Wm. H. Swift to extend to the harbor line a portion of the Thompson wharf, opposite Peck street, in the city of Providence.
4. June 2, to Wm. H. Swift to drive for temporary use, guide piles opposite Thompson wharf, the piles to be removed later.
5. July 28, to Joseph Smith and others to build a wharf on the east side of Providence river southerly from Sabin's Point.

MISCELLANEOUS.

Many matters, small individually, but of importance in the aggregate, have occupied the attention of the Commissioners and have been acted upon.

The unsafe condition of wharves, piers and other structures, sometimes endangering human life, has received serious consideration by the Commissioners. It is their firm belief that some representative of the State should have definite authority and responsibility in this matter, in the interest of public safety, and they recommend the matter to the attention of the General Assembly.

The reconstruction of the guide piling, in the neighborhood of the railroad bridge at India Point, in a new location, has received attention and the work is now going on so as to leave a clear passage of sixty feet through the draw.

WORK UNDER U. S. ENGINEER.

By the courtesy of Lieutenant-Colonel George H. Elliot, Corps of Engineers, we have been furnished with a copy of his report to the Chief of Engineers, U. S. A., for 1886, from which we have made extracts in relation to the work in Rhode Island waters under his charge previous to July 1886, which will be found in the Appendix.

We have also from Col. Elliot the statement that 21,922 cubic yards of material have been dredged in Newport harbor since the first of July last, in completing the dredging at the southern entrance to 15 feet depth at mean low water, and in continuing the excavation of that part of the inner anchorage which is to be excavated to a depth of 13 feet at mean low water. No other work has been done in that part of his district which is in Rhode Island, since July 1, 1886.

Respectfully submitted.

J. HERBERT SHEDD,
LUCIUS B. DARLING,
HENRY C. BRADFORD,
Harbor Commissioners.

APPENDIX.

EXTRACT FROM REPORT OF LIEUT.-COL. ELLIOT TO CHIEF OF ENGINEERS, U. S. A., FOR 1886.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which has a population of about 23,000, and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draught can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement, the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project as modified in 1883 provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence, the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1885.

The amount expended to June 30, 1885, was $52,718.44. The channel had

been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water. A contract had been made for deepening and widening this channel according to the modified plan of 1883, but the work had not been commenced.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. A contract, described in the last Annual Report, had been made in October, 1884, with Elijah Brainard and Thomas H. Benton, of New York, for dredging a channel 12 feet deep and 100 feet wide from the deep water just above Red Bridge as far towards the city of Pawtucket as the available funds would pay for, but the work was not to be commenced until the old Washington Bridge across the river near its mouth, which formed such an obstruction to navigation as would interfere with the passage of tows of the dredged material, should be removed. This delayed the commencement of the work till August 7, 1885, from which time it was continued until December 7, when the work was suspended for the winter by ice, and it was resumed on April 9, 1886. The time of completion of the contract was extended by authority of the Chief of Engineers to June 7, 1886, It was completed May 28, 1886, 212,734.57 cubic yards of material having been removed during the fiscal year. In November, 1885, a series of observations of the rise and fall of the tide at Pawtucket was made for future determinations of the effect of the enlargement of the water-way on the tides at that place. Mr. John S. Engs, Jr., was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR, AND RESULTS TO JUNE 30, 1886.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1886, $49,241.02. The new channel, 12 feet deep and 100 feet wide with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge, a distance of about 8,740 feet, or to a point about 1,000 feet above a line drawn from Bucklin Island to Swan Point Wharf.

This completed portion of the channel is already a great benefit to the commerce of the river and gives much satisfaction. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate by dredging the channel 12 feet deep and 100 feet wide from the point to which the last contract carried it to a point opposite Grant & Company's Wharf, and from thence to Pawtucket Bridge to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to devote the small remainder on hand July 1, 1886, and the appropriation made by the act of August 5, 1886, to the excavation by dredging of the upper reaches of the new channel, and, if the funds will admit, to the commencement of the work on the ledge which lies in the channel off Pawtucket.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $180,933. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, Rhode Island, and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1885, amount available		$49,287 52
July 1, 1886, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1885	$49,217 27	
July 1, 1886, outstanding liabilities	23 75	
		49,241 02
July 1, 1886, amount available		46 50
Amount appropriated by act approved August 5, 1886		30,000 00
Amount available for fiscal year ending June 30, 1887		30,046 50
Amount (estimated) required for completion of existing project		302,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1888		75,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

PAWTUCKET BUSINESS MEN'S ASSOCIATION,
PAWTUCKET, July 20, 1886.

DEAR SIR: Your letter of the 17th ultimo to the President of this association in relation to improvements of Pawtucket River was received in due time. In his absence I will simply state the statistics collected by the committee from this association in 1883 were substantially accurate, and correct for the last year if about 10 per cent. be added to the same.*

Yours, very respectfully,

A. K. GOODWIN,
Vice President Pawtucket Business Men's Association.

Lieut. Col. GEORGE H. ELLIOT,
Corps of Engineers, U. S. A.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city of about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation and at one point in the channel—a place called "The Crook"—the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Field's Points of the following dimension, in cross-section, viz:

---

*For papers referred to in Mr. Goodwin's communication, see Harbor Commissioners' Report, for January Session, 1886.

	Feet deep.
300 feet wide	25
600 feet wide	20
725 feet wide	18
940 feet wide	12
1,060 feet wide	6

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1885.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1885, including liabilities outstanding at that date, was $210,180.96. At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed and the condition of the six straight reaches into which the 25-foot channel, 300 feet wide, is divided, was as follows: The Fox Point, the Sassafras Point, the Field's Point, and Pomham and the Pawtuxet reaches had been completed, and the lowest, the Gaspee Reach, had been excavated to a width of 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

For want of funds no work has been in progress during the last fiscal year.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

To complete the 25-foot channel 300 feet wide, to the deep water of Narragansett Bay, there remains the increasing to 300 feet the 200 feet of width already excavated in the lowest (the Gaspee) reach. There also remains for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to devote the small remainder on hand July 1, 1886, and the appropriation made by the act of August 5, 1886, to the completion of the dredging required in the Gaspee Reach, and to continuing the excavation of the anchorage-basin above Field's Point.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected in the last fiscal year was $180,933. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island, and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1885, amount available	$3,419 67
July 1, 1886, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1885	749 93
July 1, 1886, amount available	2,669 74
Amount appropriated by act approved August 5, 1886	30,000 00
Amount available for fiscal year ending June 30, 1887	32,669 74
Amount (estimated) required for completion of existing project	205,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1888	100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

PROVIDENCE BOARD OF TRADE, SECRETARY'S OFFICE,
PROVIDENCE, R. I., June 22, 1886.

DEAR SIR: In reply to yours of the 17th, I beg leave to make reply as follows:

The whole number of arrivals at this port from foreign countries during the year 1885 was 86, of which 27 only were American, bringing—

Lumber	feet	2,562,000
Shingles		2,443,100
Laths		6,868,000
Pickets		38,000
Piling	pieces	14,200
Wood	cords	1,866
Salt	pounds	8,293,269
Logwood	pounds	5,341,000
Brimstone	tons	680

Molasses	gallons..	54,976
Potatoes	bushels..	12,102
Coffee	pounds..	17,057
Hides		184

Amount of duties collected	$189,335 10
Amount of tonnage dues	348 45

There were also received:

			Mode of transportation.
Cotton	bales..	245,607	Water and rail.
Wool	do. ..	130,849	do.
Flour	barrels..	269,277	do.
Corn	bushels..	1,671,580	do.
Coal	tons..	870,147	Water.
Lumber	feet..	37,142,308	do.

TONNAGE.

109 sail vessels, 13,800.14; 38 steam vessels, 24,945.28.

The above figures are as near as I can get them, and I have no means of separating the receipts by water and rail.

Yours, &c.,

F. P. LITTLE,
Secretary.

To Lieut. Col. GEORGE H. ELLIOT.

LETTER OF MR. GEORGE R. PHILLIPS.

PROVIDENCE, R. I., June 18, 1886.

DEAR SIR: Your favor of the 17th instant received, and contents noted. The foreign importations to the port of Providence for the year 1885 are as follows:

Lumber	feet..	2,562,000
Laths	do. ..	6,686,000
Shingles		2,431,000
Pickets		38,000
Wood	cords..	1,866
Piling	pieces..	1,420
Logwood	pounds..	5,841,000
Brimstone	tons..	680
Molasses	gallons..	54,976
Potatoes	bushels..	12,102
Coffee	pounds..	17,057
Salt	do. ..	8,293,269

The domestic importations were as follows, with some exceptions not reported:

Coal	tons	870,147
Cotton	bales	245,607
Wool	do.	130,349
Flour	barrels	269,277
Corn	bushels	1,671,580
Beef	pounds	21,707,906
Oil	barrels	88,688
Liquors	do.	108,757
Iron and steel	pounds	44,316,511
Lumber	feet	37,142,208

There has been an increase in many of the importations over last year. It is to be hoped that the General Government will take some notice of the request of many of our citizens to have Green Jacket Shoal taken away. It is a great barrier to navigation, and the space could be used to advantage as anchorage-ground.

Very truly, yours,

GEORGE R. PHILLIPS.

GEORGE H. ELLIOTT,
Lieutenant-Colonel of Engineers.

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

This is a new work, and no appropriation had been made for it until by the act of August 5, 1886, Congress authorized its commencement by making an appropriation of $26,250 therefor.

My report of January 10, 1885, of the survey of the shoal, the plat, and the estimate of the cost of the work ($112,846.25) on which the appropriation was founded, were published in the Annual Report of the Chief of Engineers for 1885, Vol. I, pages 598–602.

It is proposed, with the appropriation of August 5, 1886, to commence the work by removing that part of the shoal where additional anchorage is most required.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected during the last fiscal year was $180,933. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

COMMERCIAL STATISTICS.

For the commercial statistics, see report of the improvement of Providence River and Narragansett Bay, Rhode Island, Appendix.

MONEY STATEMENT.

Amount appropriated by act approved August 5, 1886	$26,250 00
Amount (estimated) required for completion of existing project	86,096 00
Amount that can be profitably expended in fiscal year ending June 30, 1888	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay north of the harbor of Bristol. This is a new work and no appropriation had been made for it until by act approved August 5, 1886, Congress appropriated $5,000 for the improvement of the river. In my report, January 12, 1885, of the survey made in accordance with the act of July 5, 1884, I stated that the obstructions to navigation were a rocky reef below Little Island, and a submerged bowlder near mid-channel opposite the lower wharf of the town of Warren, and recommended that this bowlder and the reef referred to be removed as far as it could be done with an expenditure of $5,000 for both purposes. They are doubtless the improvement appropriated for by act of August 5, 1886, and the funds will be expended accordingly.

A plat of the Warren River was published in the Annual Report of the Chief of Engineers for 1885, Vol. I, page 630.

MONEY STATEMENT.

Amount appropriated by act approved August 5, 1886	$5,000 00

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the mouth of the main entrance to Narragansett Bay. These waters during summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible, The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications under which we are now working are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water, and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor-line on the east, and a line drawn parallel to and 50 feet from the City wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Vol. I, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1885.

The amount expended up to the close of the fiscal year ending June 30, 1885, including liabilities outstanding at that date, was $86,966.66, with the following results: Of the area to be dredged to 13 feet within the harbor, about two-thirds had been completed, except at a few places in the northern part of the harbor where the material was found too hard for the dredge in use at the time, and except that a bulkhead was left in the extreme northeast part of the harbor to protect an anchorage for small vessels. The channel along and outside the harbor line south to a point opposite the gas company's wharf and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit had been completed. Of the 460 feet (about) of increase of width to be made between the 15-foot curves at the southern entrance by dredging the spit south of Goat Island, 224 feet had been gained.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of widening the southern entrance to the harbor by dredging Goat Island Spit to a depth of 15 feet at mean low water was in progress under a contract with the Hartford Dredging Company, of Hartford, Conn., which was described in the last Annual Report, and the time of completion of which was extended to October 1, 1885. The contract was completed September 8, 1885, and the amount of material removed during the fiscal year was 20,184.54 cubic yards. Mr. John S. Engs, Jr., from July 1 to August 1, 1885, and Capt. B. F. Case, from August 1 to September 8, were local inspectors of the work.

Several bowlders were removed from the bed of the harbor, and the stone jetty on the southwest shore of Goat Island was raised and repaired in a very substantial manner and extended to a distance of 133 feet from the shore.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR, AND RESULTS TO JUNE 30, 1886.

The amount expended during the last fiscal year was $5,853 38, and the result was the further widening of the 15-foot depth at the southern entrance by 180 feet, or to within 56 feet of the proposed northern limit of this channel, viz., a line drawn from the dolphin which marks the Goat Island Spit to clear the permanent dock at Fort Adams by 100 feet, and the effectual stopping for the present of the supply of littoral sand and gravel from the outside of Goat Island into the southern entrance by the extension and raising of the jetty on the southwest shore of the island. When the northwest angle between this jetty and the shore has been filled and the sand and gravel commence to be washed around its end, another jetty further northward on this shore will be required, but this will probably not occur for many years to come. The southern entrance is completed with the exception of the small amount of work above mentioned, and it is now wide,and safe for vessels of 15 feet draught. Of the total area to be deepened within the harbor (about 90 acres) about one-half has been completed.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

The work required to be done to complete the existing project is the small remainder of the cutting away of the spit south of Goat Island to 15 feet depth, the remainder of the excavation within the harbor of the anchorage area of 13 feet depth, and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to devote the small remainder on hand July 1, 1886, and the appropriation made by the act of August 5, 1886, to the completion of the deepening to 15 feet below mean low water of the spit south of Goat Island to the northern limit before stated; to the extension of the anchorage area within the harbor of 13 feet depth, and if the funds will allow, to the commencement of the extension, also within the harbor, of the anchorage area of 10 feet depth. It is also proposed to do a small amount of dredging at the end of the wharf at Fort Adams, at which supplies for the fort are landed.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected in the last fiscal year was $1,622.81. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1885, amount available	$6,235 37
July 1, 1886, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1885	5,853 38
July 1, 1886, amount available	381 99
Amount appropriated by act approved August 5, 1886	15,000 00
Amount available for fiscal year ending June 30, 1887	15,381 99
Amount (estimated) required for completion of existing project	52,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1888	30,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, NEWPORT, R. I.,
COLLECTOR'S OFFICE, July 13, 1886.

SIR: I have the honor to acknowledge the receipt of your letters of the 17th ultimo.

During the year ending June 30, 1886, about 5,000 vessels of all classes have arrived at this port, either for a harbor or to discharge cargoes; this includes steam and sail vessels engaged in the coasting trade, fisheries, and yachting.

During the year ending June 30, 1886, 11 vessels have arrived at this port from foreign ports and discharged their cargoes; 13 vessels have cleared from this port to foreign ports. The cargoes from foreign ports consisted of:

			Value.
Spruce boards	feet..	1,216,993	$12,827 91
Spruce laths	pieces..	115,700	1,707 72
Hemlock boards	feet..	20,849	142 44
Pine boards	do. ..	62,896	814 17
Shingles		461,000	876 25

During the same year there has been landed at this port, say:

Coal	tons..	48,000
Shingles		4,500,000
Laths		9,000,000
Lime	barrels..	12,500
Cement	" .	8,500
Brick		4,500,000
Lumber	feet..	11,500,000
Hay	tons..	1,000
Grain	bushels..	350,000

The amount of revenue collected in this district from duties on imports, tonnage tax, inspection of steam vessels, and miscellaneous receipts during the year ending June 30, 1886, was $1,622.81, the decrease from previous years being on account of changes in the law abolishing certain fees, &c.

There are 128 vessels owned and hailing from this port, viz, 107 sail, 21 steam, the tonnage of which amounts to: Gross tonnage, $5{,}644\frac{52}{100}$; net tonnage, $4{,}522\frac{41}{100}$, showing an increase over that of year ending June 30, 1885, and which will be still further increased in a few weeks by the addition of the fine new schooner James C. Clifford, gross tonnage, $377\frac{52}{100}$; net tonnage, $358\frac{65}{100}$, which has just been built in Boston to hail from this port; and also by the addition of the new ferry-boat Canonicut, which has just been launched. The tonnage of the largest vessel is $708\frac{69}{100}$ gross, $678\frac{86}{100}$ net; that of the smallest vessel, $2\frac{75}{100}$ gross, $2\frac{17}{100}$ net. The largest vessel draws 18 feet when loaded. Trusting these statistics are sufficient for your purpose.

I remain, respectfully,

J. H. COZZENS,
Collector.

Lieut. Col. GEORGE H. ELLIOT.

LETTER OF THE SUPERVISOR OF THE OLD COLONY STEAMBOAT COMPANY.

OLD COLONY STEAMBOAT COMPANY, FALL RIVER LINE,
NEWPORT, R. I., July 10, 1886.

DEAR SIR: In reply to your inquiry of the 17th ult. am pleased to inform you that the steamers of this line carried between New York and Fall River, *via* Newport, 250,000 tons of merchandise and 255,000 passengers during the year ending May 31, 1886.

Yours truly,

GEORGE PIERCE,
Supervisor.

Lieut. Col. GEORGE H. ELLIOT.

LETTER OF THE SUPERINTENDENT OF THE NEWPORT AND WICKFORD RAILROAD AND STEAMBOAT COMPANY.

Superintendent's Office.
Newport and Wickford Railroad and Steamboat Company.
NEWPORT, R. I., July 10, 1886.

SIR: In reply to yours of yesterday I have to say that our business for the year 1885, as reported to our board of directors, was as follows:

From 68,945½ passengers	$50,684 47
From carrying United States mails	8,947 56
From freights (mainly local)	3,808 12
From Adams Express Company	1,425 82
Total for the year	64,865 97

Yours, truly,

THEO. WARREN,
Superintendent.

Col. GEORGE H. ELLIOT.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station, connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which on the approach of storms were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area and inclosed, with the exception of an opening of 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap, which was found to let in too much sea in stormy weather. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Vol. I, page 612–613.

On the 8th of December, 1884, the Senate of the United States directed that report be made of the necessity and cost of enlarging the inner harbor of refuge. The report, which was accompanied by plans and an estimate of the cost ($46,189), was printed in Senate Ex. Doc. No. 27, Forty-eighth Congress, second session, and may also be found in the Report of the Chief of Engineers for 1885, Vol. I, page 610. The commencement of this work has been approved by Congress making an appropriation of $12,000 therefor in the act of August 5, 1886.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1885.

The total expenditure up to June 30, 1885, including liabilities outstanding at that date, was $318,925.09. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor, especially, was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. In 1883 a strong jetty, was built out from the cliff to the eastward of the inner harbor, and a masonry wall was constructed on the inside of the crib work forming the eastern side of the inner harbor. The major part of the sea which formerly came into the outer harbor through the gap in the main breakwater in easterly storms had, at the beginning of the last fiscal year, been stopped by the partial filling of the gap.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of filling the gap in the main breakwater was in progress under a contract with James Scully, of Groton, Conn., described in the last annual report, for furnishing riprap granite and placing the same in the gap. The contract was completed August 27, 1885, 2,376 tons of stone having been laid in the gap since the beginning of the fiscal year. In addition to this, the inside of the foot of the inner harbor east wall was covered with sand and clay to protect the pile foundation of this wall from the teredo; a stout wooden barrier was built on the east side of the inner harbor to prevent the wash of sand and gravel into the harbor in easterly storms, and ring bolts were placed in the east side of the harbor for mooring fishing and other vessels using the harbor for refuge.

A survey was made of a representative portion of the main breakwater, a greater portion of which has now for many years been exposed to the full force of the waves of the Atlantic, to see what had been the degrading effect of these waves. This breakwater was constructed of riprap granite. The width at top (which is 6 feet above mean high water) was 25 feet, the outer slope was 1 on 2, and the inner slope was 1 on 1. It was found that the inner and outer angles of the top had been rounded off and the width at top had been somewhat reduced, but the height along the axis of the breakwater had been diminished but little, and the breakwater is now as efficient a barrier against the sea as when it was constructed, and it could, if necessary, be placed in its original condition with but little cost.

Mr. Andrew R. Elliot was local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1886.

The amount expended during the last fiscal year was $5,438.79. The filling in the gap in the main breakwater was carried to the height of about 1½ feet above mean high water, and at the close of the work under the last contract about one-half of the total amount of stone required for the completion of this work had been delivered and placed in the gap. The good effects of this filling, although incomplete, have already been noticed, and vessels, both in the outer and inner harbor, lie more quietly at their moorings in easterly storms than before.

THE WHARF AT BLCCK ISLAND.

I respectfully renew my suggestion of last year respecting the Government wharf on the land side of the inner harbor of refuge at Block Island, and recommend that it be turned over to the town of New Shoreham, the corporate name of Block Island, for the public use of said town.

Before the works which form the harbor of refuge at Block Island were commenced there was, as has before been stated, no harbor at the island, nor was any wharf practicable on account of the exposure of its shores, and the small vessels there used were hauled out on the beach by oxen. During the construction of the sides of the inner harbor, which were formed of cribs of wood filled in with stone, and after they had advanced far enough to afford protection to a wharf, a small one was constructed by the United States on the land side of this harbor for temporary purposes of construction. Since the completion of the inner harbor the use of this wharf by the Government has been very slight, but all the passengers, now many thousands annually, and all the freight to and from the island, have always used, and continue to use, this wharf except that in the summer months a steamer from the mainland lands its passengers at a small private wharf in the outer harbor, but this latter wharf cannot be used at other seasons on account of the exposure of the outer harbor.

The wharf in the inner harbor, a narrow wooden wharf, is now in a dilapidated and dangerous condition, but the United States has now and prospectively so little use for it as not to warrant an estimate for its repair or reconstruction, which would cost about $2,500.

For the reason that this wharf occupies the only site available for a wharf inside the inner harbor of refuge, and outside this harbor the shore is too much exposed to the sea for any other, the continuance of its use by the inhabitants of the island is necessary, but as the case now stands they consider that, being a Government wharf, they have no right to repair it. I therefore recommend that the following provision be attached to the item for Block Island in the next river and harbor bill:

> *Provided*, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town, but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States or freight carried in such vessels.

The location of this wharf may be seen in the plat published at page 618 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

The work required to be done to complete the existing project is the completion of the filling of the gap to its full height of 6 feet above mean high water and its full width at top of 25 feet and the enlargement of the inner harbor of refuge.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to devote the small remainder on hand July 1, 1886, and the appropriation made by the act of August 5, 1886, to carrying on the filling of the gap in the main breakwater as far as the funds provided for it will admit and to the commencement of the enlargement of the inner harbor.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are four lights at the island; the north and south lights and the breakwater lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1885, amount available	$6,074 91
July 1, 1886, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1885	5,438 79
July 1, 1886, amount available	636 12
Amount appropriated by act approved August 5, 1886	20,000 00
Amount available for fiscal year ending June 30, 1887	20,636 12
Amount (estimated) required for completion of existing project	50,189 00
Amount that can be profitably expended in fiscal year ending June 30, 1888	50,189 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

BLOCK ISLAND, June 30, 1886.

SIR: In accordance with your request of the 17th instant, relative to the furnishing you with amounts of merchandise received and exported from Block Island, and the amount of vessels making use of our harbors, &c., for the year ending December 31, 1885, would respectfully make the following report, which I think is not far from correct:

AMOUNT OF MERCHANDISE RECEIVED AND EXPORTED FROM BLOCK ISLAND DURING THE YEAR ENDING DECEMBER 31, 1885.

Coal received	tons..	5,000
Iron received	do. .	200
Grain received	bushels..	11,000
Lumber received	feet..	3,500,000
General merchandise, not included in the above, shipped and received	tons..	15,000

ARRIVAL AND DEPARTURE OF VESSELS.

Steamers, from 50 to 1,000 tons	1,850
Sailing vessels, from 10 to 200 tons, from 2 to 10 feet draught	112,000

These figures cover all vessels that make Block Island Bay Harbor.

All of which is respectfully submitted.

NICHOLAS BALL.

Lieut. Col. GEORGE H. ELLIOT,
Corps of Engineers, U. S. A.

IMPROVEMENT OF LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

Little Narragansett Bay lies on the north side of the eastern entrance from the ocean into Long Island Sound; Pawcatuck River, upon which is situated the important commercial and manufacturing town of Westerly, R. I., empties into the eastern side of the bay, and has been improved by the United States. The object of the improvement of Little Narragansett Bay was to deepen the approach from Long Island Sound to Westerly.

The mean rise and fall of the tide is 2.63 feet.

ORIGINAL CONDITION.

The navigable draught of water through the bay before improvement was about 4½ feet at mean low water.

PLAN OF IMPROVEMENT.

The project of 1878 for the improvement of the bay provided for a channel 200 feet wide and 7½ feet deep at mean low water from the entrance to the bay to the mouth of the Pawcatuck, and the removal of the bowlders which then obstructed navigation and any others which the excavation of the channel might develop. Subsequently, it was determined to clear away some large bowlders which interfered with steamboat navigation between this channel and Watch Hill Landing. The estimated cost of the improvement was $51,000.

A plat of Little Narragansett Bay, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1879, page 314.

AMOUNT EXPENDED AND RESULTS.

The project was completed in the fiscal year 1883-'84. The main channel as projected was excavated to its full width and depth, and many bowlders were removed from the Watch Hill Channel. Vessels drawing 10 feet of water can now reach the mouth of the Pawcatuck River at high water, but the full benefit of the improvement cannot be utilized until further deepening of that river to enable vessels of the same draught to reach Westerly.

A report on the further improvement of the Pawcatuck was submitted September 19, 1884, in compliance with the river and harbor act of Congress of July 5, 1884, which was printed as House Ex. Doc. No. 183, Forty-eighth Congress, second session, and is also contained in the Report of the Chief of Engineers for 1885, Vol. I, page 623.

The remainder of the last appropriation for Little Narragansett Bay is reserved for comparative surveys of Sandy Point, at the entrance to the bay, which seems to be affected by the construction of the breakwater in Stonington Harbor, and for range marks on Pawcatuck Point to guide through the new channel. The total cost of the completed improvement was $35,856.96.

Little Narragansett Bay is in the collection district of Providence and Stonington, the dividing line passing through the bay. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $180,933; Stonington, $1,735.69. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1885, amount available	$143 04
July 1, 1886, amount available	143 04

[illegible] 1010

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, A. D. 1888.

PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1888.

State of Rhode Island and Providence Plantations.

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E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1888.

HARVARD COLLEGE
MAY 29 1917
LIBRARY

The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.

The Board of Harbor Commissioners respectfully submit their Twelfth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, appointed William C. Clarke of South Kingstown, to serve as Harbor Commissioner for a term of three years from the first of July.

HARBOR LINES.

A harbor line from Kettle Point to five hundred feet south of Nayatt Light, a distance of about six and three-eighths miles, upon which hearings had been held in 1886, was devised in January, 1887, and upon being reported to the Governor and Senate was approved in the Senate May 5, pursuant to Resolution No. 38, as attested on the plan by Joshua M. Addeman, Secretary of State—and approved on the same day by George Peabody Wetmore, Governor. The customary plans, in duplicate, are on file in the office of the Secretary of State and in the office of the Harbor Commissioners.

In their last annual report the Harbor Commissioners suggested that action be taken in relation to encroachments on the Pawcatuck river at Westerly. Subsequently a joint, or Inter-State, Commission was constituted by the Assembly of Rhode Island and by the State Government of Connecticut to consider and report upon the matter of encroachment, or harbor lines in the river, and the progress attained in their investigation will be made the subject of a special report.

ENCROACHMENTS AND DUMPING.

The usual need of supervision, by the Commissioners, to prevent injury by encroachments and dumping in public waters, has continued during the year. Permits for limited amounts of local dumping have been given under restrictions to C. W. Anthony, Joseph Provuncher, to C. W. Anthony on behalf of the City of Providence and again on behalf of the Providence and Worcester Railroad Corporation.

The Commissioners renew their suggestion that a fuller definition be made of their power to act in cases where the dumping of material above the limits of tide water makes it liable to be washed by freshets into the tide water channels and thus interfere with navigation.

The need for supervision to prevent the dumping of ashes from steamers, where it would be injurious, still continues.

LICENSES, ETC.

Licenses have been issued as follows:

No. 69. February 2, to Richard W. Comstock, to reconstruct, by piling, his wharf front, near South Water street below Gold street, in the City of Providence.

No. 70. March 9, to the West Providence Land Company, to fill lots numbered 323, 324, 325 and 356 on the What Cheer Plat, situated near Gano and Power streets, in the city of Providence.

No. 71. March 16, to Joseph Provuncher to dredge earth from the flats near his Marine Railway in East Providence, and deposit the same opposite the adjoining land of Robert Pettis, agreeably to assent given by said Pettis.

No. 72. April 20, to Sylvester G. Martin to extend his wharf, at Silver Spring, in the town of East Providence.

No. 73. April 20, to Jabez L. Harris to remove rocks and build a wall on the northerly side of his lots bordering on Pawtuxet river near the bridge, in the village of Pawtuxet, in the town of Warwick.

No. 74. April 30, to the Boston and Providence Railroad Corporation to erect temporary supports under its bridge at India Point, in the city of Providence.

No. 75. May 18, to George E. Newell, surviving partner of Smith Grant & Co., to repair the wharf of Smith Grant & Co., in Pawtucket, by replacing and driving new piling.

No. 76. May 25, to the Providence & Stonington Steamship Company to repair their wharf at Fox Point, in the city of Providence, with new piling.

No. 77. June 15, to J. A. Dailey & Son, to repair a wharf belonging to the Simmons estate at the foot of South street, in the city of Providence.

No. 78. June 29, to Albert H. Manchester to drive fender piles and repair his wharf opposite No. 460 Eddy street, in the city of Providence.

No. 79. July 6, to Thomas J. Hill to rebuild his wharf on South Water street, near Tockwotton street, in the city of Providence.

No. 80. July 13, to the city of Providence to drive two piles for temporary use, near India street, opposite South Main street, in the city of Providence.

No. 81. October 5, to Hopkins, Pomroy & Co. to change the end of the wharf known as Peck's wharf, and to drive piles; the wharf being in the rear of No. 184 Dyer street, in the city of Providence.

No. 82. October 8, to the Providence, Warren & Bristol Railroad Co. to rebuild abutments and enlarge them for a double track at the bridge below Kettle Point, in the town of East Providence.

No. 83. October 8, to F. E. Perkins to rebuild his wharf at the foot of South Main street, in the city of Providence.

No. 84. October 19, to the Continental Steamboat Co to drive spring piles at the wharf of Thomas J. Hill, near South Water street, opposite Shamrock street, in the city of Providence.

No. 85. November 2, to George Turner, Trustee, to extend bridge wharf on the Eben Simmons estate near Point street, in the city of Providence.

No. 86. November 2, to George Turner, Trustee, to extend bridge wharf on the Eben Simmons estate, near South street, in the city of Providence.

No. 87. November 23, to George Turner, Trustee, to build a stone wall above a pile foundation, along the southerly side of the first slip southerly of South street, in the city of Providence.

No. 88. December 13, to the Providence & Worcester Railroad Company to rebuild a pile bridge situated between Weybosset and Exchange Place bridges, in the City of Providence.

Assent has been given as follows:

1. May 18, to John Carpenter to build a wharf in the waters of Coweset Bay about three-quarters of a mile below Apponaug.
2. June 8, to William G. Low to build a wharf at Bristol nearly opposite the north end of Hog Island.
3. September 7, to John Smith to widen his wharf at Warren, twenty feet, the full length thereof.
4. October 5, To John Smith to widen his wharf at Warren, a further amount of thirty feet.
5. October 19, to the Rocky Point Oyster Company to lay oysters temporarily, for fattening purposes, at Mill Cove, south of Conimicut Point, above low water mark, and with the consent of the riparian owners.

RAILROAD BRIDGE AT INDIA POINT.

In response to a notable petition from parties interested in the matter of a wide opening in the railroad draw-bridge at India Point, and after hearings and a personal examination, the Commissioners notified the Boston & Providence Railroad Corporation, in January, to remove the obstructions to navigation in and near the draw so that a clear and reasonably direct passage-way for vessels may be maintained through the draw sixty feet in width. The work was well in progress in April, and subsequent inspection showed the work to be satisfactorily and substantially done.

WRECKS.

The attention of the Commissioners has been called to obstructions to the free use of the public waters by reason of abandoned wrecks of vessels. Where responsible owners can be found it may usually be possible to rid the waters of these obstructions without expense to the State, but some further legislation seems desirable to provide for the removal of wrecks or other obstructions where the value of the wreck will not pay for removal, and responsible owners are not found or are beyond reach.

WHARVES.

Further legislation seems also to be required to provide for the safety of the public in the use of wharves and other structures where they are unsound or too weak for the large crowds frequently taken upon excursions in the bay. An authorized inspection with power to require the owners to maintain all structures in a safe and permanently secure condition would be advantageous.

BRIDGE-DRAWS.

More definite provisions as to the times for opening bridge-draws for the passage of vessels and as to the blocking of approaches to the draws would be useful.

SHIPPING AND THE RAILROADS.

The facilities for transferring freight between the shipping and railroads are not satisfactory. Situated near the northern limit of safe coastwise navigation, Providence should be the most important distributing point for coastwise freight designed for New England, and the gathering point for New England products to be sent southerly by vessels. It is believed to be feasible to connect every railroad entering Providence with every wharf of importance, so that all the wharves may practically become the freight yards for the railroads and making it unnecessary for the roads to have any extensive yards elsewhere. In this connection the present freight tracks through the central crowded streets of Providence should be removed and all business be done on tracks circling the city along the wharves. Under such a plan, while the ordinary railroad freight business might be more economically and satisfactorily accomplished the union with the shipping would be intimate and valuable. The important problem of Improved Railroad Terminal Facilities being likely to engage the attention of the General Assembly, it would, in the opinion of the Harbor Commissioners, be well to consider with it the related business of water transportation.

WORK UNDER U. S. ENGINEER.

By the courtesy of Major William R. Livermore, Corps of Engineers, we have been furnished with a copy of his report to the Chief of Engineers, U. S. A., for 1887, upon the work of which he is now in charge, from which we have made extracts in relation to the work in Rhode Island waters previous to July, 1887, which will be found in the Appendix.

Respectfully submitted,

J. HERBERT SHEDD,
HENRY C. BRADFORD,
WILLIAM C. CLARKE,
Harbor Commissioners.

APPENDIX.

EXTRACT FROM REPORT OF MAJOR WILLIAM R. LIVERMORE TO CHIEF OF ENGINEERS, U. S. A., FOR 1887.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay north of the harbor of Bristol. This is a new work, and no appropriation had been made for it until, by act approved August 5, 1886, Congress appropriated $5,000 for the improvement of the river. In his report, January 12, 1885, of the survey made in accordance with the act of July 5, 1884, Colonel Elliot stated that the obstructions to navigation were a rocky reef below Little Island and a submerged bowlder near mid-channel opposite the lower wharf of the town of Warren, and recommended that this bowlder and the reef referred to be removed as far as it could be done with an expenditure of $5,000 for both purposes.

PLANS OF IMPROVEMENT.

The work of improvement is one that cannot be well carried on by contract, and the approved project is first to remove Bushworth Rock, and afterwards to remove the bowlders which lie submerged on the western side of the narrowest portion of the channel at Little Island, and also the projecting portions of the ledge beneath the bowlders, widening the channel as much as the funds available will allow; it also includes the hiring in open market of a vessel with working crew, submarine diver, firing battery, and steam hoisting apparatus, and purchase of the explosives also in open market.

At the close of the last fiscal year the work had not been commenced.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to devote the available funds to the prosecution of the work in accordance with the approved project, which will be commenced in a few weeks.

Warren River is in the Bristol-Warren collection district, which is a port of entry. The amount of revenue collected in the last fiscal year was $——— (unknown). The nearest light-house is the light-house on Conimicut Point, Providence River. The nearest fortifications are fort on Dutch Island, and Fort Adams, R. I.

MONEY STATEMENT.

Amount appropriated by act approved August 5, 1886		$5,000 00
July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$8 10	
July 1, 1887, outstanding liabilities	22 40	
		30 50
July 1, 1887, amount available		$4,969 50

COMMERCIAL STATISTICS.

[Furnished by Mr. D. B. Barton, Warren, R. I., for the year 1884.]

RECEIPTS.

Article.	Quantity.	Article.	Quantity.
Coal ... tons.	17,743	Cotton ... bales.	1,661
Corn ... bushels.	43,373	Lumber ... feet.	486,000

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which has a population of about 23,000, and extensive manufactures, depending largely on water transportation. The obejct of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draught can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project as modified in 1883 provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water, from the deep water above Red Bridge to the ledge opposite Grant & Co's wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886.

The amount expended to June 30, 1886, was $101,959.46. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel, 12 feet deep and 100 feet wide, with wide enlargements at the bends, had been carried from its mouth at the deep water just above Red Bridge, a distance of about 8,740 feet, or to a point about 1,000 feet above a line drawn from Bucklin Island to Swan Point Wharf.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. The project for the expenditure of the appropriation of $30,000 of August 5, 1886, approved by the Chief of Engineers, was the continuation of the enlarged channel (which has now been carried up-river a little above Swan Point) as far towards Pawtucket as the funds will allow, affording at the same time such relief as the commerce may require at the shoalest places above the main work. Advertisements were issued October 4, 1886, inviting proposals for the dredging. The bids received and terms of contract will be found in appended table.

Work was commenced May 14, 1887, and continued to the end of the fiscal year; 81,069.18 cubic yards were excavated up to June 30, 1887. Capt. M. S. Persons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year including liabilities outstanding June 30, 1887, was $9,010.24, and the result was the extension of the channel about 1,200 feet up the river.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate, by dredging, the channel 12 feet deep and 100 feet wide from about 500 feet below Bishop's Point to a point opposite Grant & Company's Wharf, and thence to Pawtucket Bridge to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the remainder on hand July 1, 1887, of the appropriation made by the act of August 5, 1886, to the completion of the channel up to the neighborhood of Bensley's Point, and in removing some of the shoalest points above the main work.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $222,195.01. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1886, amount available		$46 50
Amount appropriated by act approved August 5, 1886		30,000 00
		30,046 50
July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$3,148 50	
July 1, 1887, outstanding liabilities	5,861 64	
		9,010 24
July 1, 1887, amount available		21,036 26
Amount (estimated) required for completion of existing project		$302,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		50,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated October 4, 1886, *and opened at* 12 *o'clock, noon, on Wednesday, October* 27, 1886.

No.	Name and address of bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	Elijah Brainard, New York, N. Y.	25	Work to be commenced within thirty days after signing of contract, unless otherwise agreed in writing, and to be completed on or before June 30, 1887.
2	Richard M. Payn, Albany, N. Y.	26	
3	Morris & Cumings Dredging Company, New York, N. Y.	29	
4	P. Sanford Ross, Jersey City, N. J.	30	
5	Thomas H. Benton, Elizabeth, N. J.	30	

Contract awarded to Elijah Brainard, with the approval of the Chief of Engineers, and dated November 19, 1886. Time of commencement extended to May 5, 1887, and time of completion to December 1, 1887.

COMMERCIAL STATISTICS.

[Furnished by Business Men's Association, Pawtucket, R. I.]

IMPORTS.

Articles.	Quantity.	Articles.	Quantity.
Coal .... tons..	86,000	Ammonia Water .... barrels..	210,000
Iron .... do...	5,300	Lime .... do. ..	2,500
Gravel .... do...	300	Cement .... do. ..	15,000
Clay .... do...	50	Long Lumber .... feet....	9,000,000
North River Stone .... do...	500	Short Lumber, as shingles, laths, clapboards, etc .. feet....	3,000,000
Paving Stone.... .... do...	240	Spool Lumber (about)..... do. ..	2,000,000
Brick	2,000,000		

The above merchandise was received chiefly by barges and sailing vessels carrying from 150 to 600 tons each, and drawing from 7½ to 11 feet of water.

The number of water-craft passed through the draw-bridge for the year was about as follows:

Class.	No.	Class.	No.
Steamboats	402	Miscellaneous	458
Tow-boats	760	Total	2,281
Sailing vessels	413		
Sail-boats	248		

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city of about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field's Points of the following dimensions in cross section, viz :

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1886, including liabilities outstanding at that date, was $210,930.89. At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed, and the condition of the six straight reaches into which the 25-foot channel, 300 feet wide, is divided was as follows : The Fox Point, the Sassafras Point, the Field's Point, the Pomham and the Pawtuxet reaches had been completed, and the lowest, the Gaspee Reach, had been excavated to a width of 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

The project for the expenditure of the appropriation of $30,000, made by act of Congress August 5, 1886, was (1) the completion of the excavation of the Gaspee Reach of a channel 300 feet wide and 25 feet deep, and (2) the excavation, as far as the remainder of the funds will admit, of that part of the anchorage-basin above Field's Point which is to be excavated to a depth of 20 feet. Advertisements were issued October 4, 1886, inviting proposals for the work of dredging in accordance with this project. The bids received and terms of contract will be found in the appended table. Work was commenced on the contract with W. H. Beard, of Brooklyn, N. Y., April 18, 1887, and was in progress at the end of the fiscal year, 111,372 cubic yards having been excavated up to that time.

Mr. W. C. Simmons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1887, was $11,905,79. The result was the widening of the Gaspee to its full width of 300 feet and the excavation of nearly one-half of the 20-foot anchorage area in the Fox Point Reach.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage-basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the remainder on hand July 1, 1887, of the appropriation made by the act of August 5, 1886, to the completion of the dredging required in the 20-foot anchorage-basin above Field's Point, and the commencement of the 18-foot anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $222,195.01. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1886, amount available	$2,669 74
Amount appropriated by act approved August 5, 1886	30,000 00
	32,669 74

July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$6,412 39	
July 1, 1887, outstanding liabilities	5,493 40	
		11,905 79
July 1, 1887, amount available		20,763 95
Amount (estimated) required for completion of existing project		205,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		100,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Providence River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated October 4, 1886, and opened at 12 o'clock noon, on Wednesday, October 27, 1886.

No.	Name and Address of Bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	William H. Beard, Brooklyn, N. Y	8⅛	Work to be commenced within thirty days after signing the contract unless otherwise agreed in writing, and to be finished on or before June 30, 1887.
2	Atlantic Dredging Company, Brooklyn, N. Y	8 8-9	
3	P. Sanford Ross, Jersey City, N. J	10	
4	Morris & Cummings Dredging Company, New York, N. Y.	10⅛	
5	National Dredging Company, Wilmington, Del	13	

Contract awarded to William H. Beard, with the approval of the Chief of Engineers, and dated November 18, 1886. Time of commencement extended to April 1, 1887, and time of completion to August 31, 1887.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

ARRIVALS IN EIGHTY-EIGHT FOREIGN VESSELS.

Articles.	Quantity.	Articles.	Quantity.
Lumber .feet..	8,195,000	Brimstone tons..	1,185
Shingles	2,877	Potatoes bushels..	33,311
Laths	13,715	Coal tons..	966
Pickets	10,480	Scrap iron pounds..	10,900
Cord-wood	575	Potato starch casks..	646
Salt pounds..	6,529,595	Brandy gallons..	4,065
Logwood tons..	2,448		

TOTAL ARRIVALS.

Articles.	Quantity.	Articles.	Quantity.
Cotton.................bales..	215,140	Corn.....................bushels..	1,217,000
Wool..........bales and sacks..	125,593	Dry Goods..................cases .	97,544
Coal.........................tons..	1,037,000	Chemicals..............packages..	106,643
Iron and steel...............do. ..	20,071	Hardware......................tons..	2,322
Lumber.........................feet..	57,632,715	Waste...................pounds..	13,946,000
Oil..........................barrels..	139,148	Liquor.....................barrels..	68,328
Flour..........................do....	277,061		

TONNAGE.

Vessels.	No.	Tonnage.
Sail..	105	16,014.74-100
Steam...	38	19,167.15-100

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

This is a new work, and no appropriation had been made for it until by the act of August 5, 1886, Congress authorized its commencement by making an appropriation of $26,250 therefor.

The report of the survey of the shoal made by Colonel Elliot, the plat, and the estimate of the cost of the work ($112,346.25) on which the appropriation was founded, were published in the Annual Report of the Chief of Engineers for 1885, Vol. I., pages 598–602.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

OPERATIONS DURING THE LAST FISCAL YEAR.

Advertisements were issued October 4, 1886, inviting proposals for dredging under the approved project.

The bids received and the terms of the contract will be found in the appended table.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended, including outstanding liabilities to June 30, 1887, was

$767.47. At the close of the last fiscal year the work of dredging had not commenced.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the remainder on hand July 1, 1887, of the appropriation of August 5, 1886, to the removal of as much of the shoal where additional anchorage area is most needed to the depth of 25 feet as far as the funds will allow.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $222,195.01. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

Amount appropriated by act approved August 5, 1886		$26,250 00
July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$654 56	
July 1, 1887, outstanding liabilities	112 91	
		767 47
July 1, 1887, amount available		25,482 53
Amount (estimated) required for completion of existing project		86,096 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		50,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for the removal of Green Jacket Shoal, Providence Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated October 4, 1886, and opened at 12 o'clock noon, on Wednesday, October 27, 1886.

No.	Name and Address of Bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	Wm. H. Beard, Brooklyn, N. Y	10½	Work to be commenced within thirty days after signing of contract unless otherwise agreed in writing, and to be finished on or before June 30, 1887.
2	Atlantic Dredging Company, Brooklyn, N. Y	11 4-9	
3	P. Sanford Ross, Jersey City, N. J	14	
4	Elijah Brainard, New York, N. Y	15	
5	National Dredging Company, Wilmington, Del.	16	
6	Morris & Cummings Dredging Company, New York, N. Y.	18	

Contract awarded to William H. Beard, with the approval of the Chief of Engineers, and dated November 18, 1886. Time of commencement extended to August 1, 1887, and time of completion to November 30, 1887.

COMMERCIAL STATISTICS.

For the commercial statistics, see report of the improvement of Providence River and Narragansett Bay, Rhode Island.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the mouth of the main entrance to Narragansett Bay. These waters during summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3¼ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge, The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications under which we are now working are substantially as follows :

Deepening the southern entrance to 15 feet at mean low water, and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island, to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Vol. 1, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886.

The amount expended up to the close of the fiscal year ending June 30, 1886, including liabilities outstanding at that date, was $92,820.04, with the following results:

Of the area to be dredged to 13 feet within the harbor, about two-thirds had been completed, except at a few places in the northern part of the harbor, where the material was found too hard for the dredge in use at the time, and except that a bulkhead was left in the extreme northeast part of the harbor to protect an anchorage for small vessels. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The 460 feet (about) of increase of width to be made between the 15-foot curves at the southern entrance, by dredging the spit south of Goat Island, had been completed, with the exception of a strip of about 56 feet in width.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. An appropriation of $15,000 having been made by act of Congress of August 5, 1886, for continuing the improvement, advertisements were issued on September 18, 1886, inviting proposals for dredging under the approved project. The bids received and terms of contract will be found in appended table. The work of dredging was commenced October 27, 1886, and continued until December 30, 1886, when it was temporarily suspended on account of ice. It was recommenced March 5, 1887, and was in progress at the end of the fiscal year; 56,352.6 cubic yards were excavated up to that date.

Mr. David Hamilton, in October and November, 1886; Mr. T. A. Churbuck, in November, 1886; Mr. Charles D. Marsh, in November and December, 1886; Mr. M. S. Persons, from March to May, 1887; and Mr. Theo. Topham, in May and June, 1887, were local inspectors of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1887, was $14,743.83, and the result was the completion of the 15-foot channel at the southern entrance to the inner harbor, and the channel around and to the eastward of the dolphin on Goat Island Spit completed, with the exception of a narrow strip along its western edge, about nine-tenths of the 18-foot anchorage area; and of the total area to be deepened within the harbor (about 90 acres), about two-thirds have been completed. The berth for vessels at the quartermaster's wharf at Fort Adams, was deepened to 10 feet at mean low water, and the effectual stopping for the present of the supply of littoral sand and gravel from the outside of Goat Island into the southern entrance by the jetty on the southwest shore of the island. When the northwest angle between this jetty and the shore has been filled, and the sand and gravel commence to be washed around its end, another jetty further northward on this shore will be required. The southern entrance is completed for vessels of 15 feet draught.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island Spit; the remainder of the excavation within the harbor of the anchorage area of 18 feet depth, and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the small remainder on hand July 1, 1887, of the appropriation made by the act of August 5, 1886, to extending the 13-foot anchorage area and removing a few bowlders therefrom.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184 51. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1886, amount available	$381 99
Amount appropriated by act approved August 5, 1886	15,000 00
	15,381 99

July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$11,954 75	
July 1, 1887, outstanding liabilities	2,789 08	
		14,743 83
July 1, 1887, amount available		638 16
Amount (estimated) required for completion of existing project		52,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		30,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging Newport Harbor, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated September 18, 1886, and opened at 12 o'clock noon, Monday, October 4, 1886.

No.	Name and address of bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	Hartford Dredging Company, Hartford, Conn	21⅞	Work to be commenced within twenty days after signing of contract, and to be finished on or before June 30, 1887.
2	W. H. Beard, Brooklyn, N. Y	24	
3	John McDermott, Cohoes, N. Y	24⅜	
4	Elijah Brainard, New York, N. Y	32	
5	Richard M. Payn, Albany, N. Y	34	
6	The Frank Pidgeon Dredging Company, New York, N. Y.	39	
7	A. B. Martin, Boston, Mass	39	

Contract awarded to the Hartford Dredging Company, with the approval of the Chief of Engineers, and dated October 18, 1886. Time of completion extended to July 30, 1887.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

RECEIPTS OF MERCHANDISE.

Coal . . . tons	50,000	Cement . . . barrels	9,000
Shingles	5,000,000	Brick	5,000,000
Laths	8,500,000	Lumber . . . feet	12,500,000
Lime . . . barrels	13,000	Hay . . . tons	1,000
Potatoes . . . bushels	2,600	Grain . . . bushels	350,000

There are 132 vessels owned and hailing from this port, viz., 107 sail, 25 steam, the tonnage of which amounts to 6,322.08 gross, 5,051.34 net. Tonnage of the smallest vessel 2.75 gross, 2.17 net. The largest vessel draws 18 feet when loaded.

BUSINESS OF THE OLD COLONY STEAM-BOAT COMPANY FOR YEAR ENDING MAY 31, 1887.

[Furnished by Mr. George Pierce, Supervisor.]

Passengers carried between New York and Fall River, via Newport. .... No..	280.000
Merchandise, via Newport.. tons..	265,000

BUSINESS OF THE NEWPORT AND WICKFORD RAILROAD AND STEAM-BOAT COMPANY FOR THE YEAR 1886.

[Furnished by Mr. C. U. Coffin, agent.]

Receipts.	Amount.
Sale of tickets	$50,352 25
Adams Express Company	1,448 96
Carrying U. S. Mail	8,947 56
Total	60,748 77

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap, which was found to let in too-much sea in stormy weather. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Vol. I, pages 612, 613.

On the 8th of December, 1884, the Senate of the United States directed that report be made of the necessity and cost of enlarging the inner harbor of refuge. The report, which was accompanied by plans and an estimate of the cost ($46,189), was printed in Senate Ex. Doc. No. 27, Forty-eighth Congress, second session, and may also be found in the Report of the Chief of Engineers for 1885, Vol. I, page 610. The commencement of this work has been approved by Congress making an appropriation of $12,000 therefor in the act of August 5, 1886.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886

The total expenditure up to June 30, 1886, including liabilities outstanding at that date, was $324,363 88. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance. to 9 feet at mean low water. In 1883 a strong jetty was built out from the cliff to the eastward of the inner harbor, and a masonry wall was constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling in the gap in the main breakwater was carried to the height of about 1¼ feet above mean high water, and at the close of the work under the last contract about one-half of the total amount of stone required for the completion of this work had been delivered and placed in the gap. The sea which formerly came into the outer harbor through the gap in the main breakwater in easterly storms had been stopped by this partial filling.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. An appropriation of $20,000 having been made by the act of Congress of August 5, 1886, for enlarging the inner harbor and filling the gap in the main breakwater, advertisements were issued March 21, 1887, for furnishing rip rap granite for main breakwater, and for the commencement of the enlargement of the inner harbor in accordance with the project referred to above. The bids received and terms of the contract will be found in the appended table.

AMOUNT EXPENDED DURING LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year was $660.29. Work under the present project had not been commenced.

THE WHARF AT BLOCK ISLAND.

In his last Annual Report Col. Elliot recommended that the Government wharf on the land side of the inner harbor of refuge at Block Island should be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

> *Provided*, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town, but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

The location of this wharf may be seen in the plat published at page 613 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap to its full height of 6 feet above mean high water and its full width at top of 25 feet, and the enlargement of the inner harbor of refuge.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the funds on hand July 1, 1887, to carrying on the filling of the gap in the main breakwater, as far as the funds provided for it will admit, and to the commencement of the enlargement of the inner harbor.

Block Island is in the Newport collection district and Newport is the nearest port of entry. The revenue collected at Newport in the last fiscal year was $2,184 51. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are four lights at the island, the north and south lights, and the breakwater lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1886, available	$636 12
Amount appropriated by act approved August 5, 1886	20,000 00
	20,636 12

July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$447 81	
July 1, 1887, outstanding liabilities	212 48	
		660 29
July 1, 1887, amount available		19,975 83
Amount (estimated) required for completion of existing project		50,189 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		50,189 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing riprap granite for filling the gap in the main breakwater, and for the commencement of the enlargement of the inner harbor at Block Island, received at Engineer office, United States Army, Newport, R. I., in response to advertisement dated March 21, 1887, and opened at 12 o'clock, noon on Thursday, April 21, 1887.

[Work to be commenced thirty days after signing of contract, except otherwise agreed in writing, and to be finished on or before July 1, 1888.]

Articles.	1. WM. H. Molthrop & Co., New London, Conn.	2. James Scully, Groton, Conn.	3. John A. Bouker, New York, N. Y.	4. Chas. H. Edwards, Boston, Mass.	Approximate quantities required.
Hard pine timber, in place, per M feet B.M.	$40 00	$37 00	$60 00	$50 00	2,200 feet.
Hard pine plank, in place ... ..do	43 60	37 00	60 00	55 00	5,000 feet.
Wrought iron, in place......per pound	07	10	10	10	2,100 pounds.
Wrought iron spikes, in place...do	07	10	10	08	200 pounds.
Beef or pork......per barrel	2 50	2 00	3 00	2 00	62 barrels.
Riprap granite: per ton of 2,240 pounds	1 59	1 59	1 61	1 64	10,500 tons.
Gross amount of bid for estimated quantities	17,314 00	17,315 40	17,753 00	17,955 00	

Contract awarded to William H. Molthrop & Co., with the approval of the Chief of Engineers, and dated May 11, 1887. Time of commencement extended to July 15, 1887.

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Report on the arrival and departure of steam and sail vessels, together with imports and exports to and from Block Island, for the year ending December 31, 1886.

Articles.	Quantity.
Coal received (about) ...tons...	5,300
Iron received (about) ....do....	225
Grain received (about) ....bushels..	12,000
Lumber received (about) ...feet...	4,000,000
General Merchandise, not included in the above, imported and exported ....tons...	15,000

Arrivals and Departures for the year.

	Number.
Steamers from 50 to 1,000 tons, drawing from 3 to 10 feet of water	1,890
Sailing vessels from 10 to 200 tons, from 2 to 6 feet draught (about)	116,000

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river, and 2.80 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water.

PLANS OF IMPROVEMENT.

By means of appropriations made in the years 1871–'75, the river was improved by the United States by the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the lower and upper wharves. Colonel Elliott's report of a resurvey of the river made in compliance with the river and harbor act of July 5, 1884, which was accompanied by a plat and an estimate of cost ($38,637.50) and was published in the Report of the Chief of Engineers for 1885, Vol. I, pages 623-

625, recommended the further widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and upper wharves; also the deepening of the entire channel to 8 feet at mean low water.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886.

The amount expended on the original project was $50,000, and it was completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

An appropriation of $12,000 having been made by act of Congress of August 5, 1886, advertisements were issued October 4, 1886, inviting proposals for dredging under the approved project. The bids received and terms of contract will be found in appended table.

The work of dredging was commenced in the lower reaches of the river April 21, 1887, and 19,721.33 cubic yards were excavated up to the end of the fiscal year, at which time the work was still in progress.

Mr. A. H. Dickens was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1887, was $8,585.12, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to Certain Draw Point, with the exception of a small amount of ledge rock which extends into the channel near the latter point.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water, and width of 100 feet from Certain Draw Point to Westerly, and a width of 40 feet between the upper and lower wharves of that town.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to continue the work of widening and deepening the channel according to the new project as far toward Westerly as the funds will admit, which will carry the work to about Major's Island, and also to afford such relief as the commerce of the river may require at the shoalest places in advance of the main work.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $222,195.01; Stonington, $1,112.22. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

Amount appropriated by act approved August 5, 1886		$12,000 00
July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$2,150 55	
July 1, 1887, outstanding liabilities	1,384 57	
		3,535 12
July 1, 1887, amount available		8,464 88
Amount (estimated) required for completion of existing project		26,637 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		26,637 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Pawcatuck River, Rhode Island and Connecticut, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated October 4, 1886, and opened at 12 o'clock, noon, on Wednesday the 27th day of October, 1886.

No.	Name and address of bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	A. J. Beardsley & Son, Bridgeport, Conn	12⅛	Work to be commenced within thirty days after signing contract, unless otherwise agreed in writing, and to be finished on or before June 30, 1887.
2	Richard M. Payn, Albany, N. Y	13⅝	
3	The Frank Piegeon Dredging Company, New York, N. Y	16 95-100	
4	Hartford Dredging Company, Hartford, Conn	21 7-10	
5	John McDermott, Cohoes, N. Y	23⅛	
6	Morris & Cummings Dredging Company, New York, N. Y.	32	
7	Elijah Brainard, New York, N. Y	35	

Contract awarded to A. J. Beardsley & Son, with the approval of the Chief of Engineers, and dated November 17, 1886. Time of commencement extended to May 1, 1887, and time of completion to November 15, 1887.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. Irving Maxon, Westerly, R. I.]

RECEIPTS AT WESTERLY, RHODE ISLAND, IN 1886.

Articles.	Quantity.	Articles.	Quantity.
Coal....tons...	18,447	Iron....tons...	825
Water pipes....	1,283	Sand....do....	955
Lumber....feet...	4,279,312	Bricks....	331,800
Grain....bushels.	55,000	Wood....cords...	463

SHIPMENTS.

Stone....tons..2,286.

One hundred and eighty-two vessels were towed and fifteen sailed up the river with full cargoes. Forty-two vessels for Westerly, in addition, were obliged to discharge at Stonington because of insufficient depth of water in Pawcatuck River. Their cargoes were towed up on lighters and consisted of 3,862,812 feet of lumber.

LATER WORK OF U. S. ENGINEERS.

By courtesy of Maj. W. R. Livermore, engineer in charge, we have received, under date of April 3, 1888, further information of the work under his direction, bringing the account to the close of the season.

1. PAWTUCKET RIVER.

The channel 100 feet wide and 12 feet deep at mean low water, which has been in process of excavation under contract with Elijah Brainard of New York, dated Nov. 19th, 1886, has been continued. The dredging has been in the vicinity of Bishop's Point and between this place and Bass Rock. On Oct. 6th, when the present contract was completed, there was a channel open to navigation 100 feet wide and 12 feet deep at mean low water, from the deep water above Red Bridge to a point about 4,000 feet north of a line drawn from Bucklin's Island to Swan Point wharf, and a ruling depth of 6 feet can now be carried from the upper end of the present work to Pawtucket. The total amount of material dredged from June 30th until Oct. 6th, was 72,248.58 cubic yards.

2. PROVIDENCE RIVER.

The project providing for a 300 feet channel, 25 feet deep at mean low water, from Fox Point in the city of Providence to the deep water of Narragansett Bay, has been carried out under contract with W. H. Beard of Brooklyn, N. Y., dated Nov. 18th, 1886, (extended for completion to Oct. 15th, 1887). The entire channel has been completed and at the completion of the contract on Oct. 12th 1887, about three-fifths of the anchorage basin had been dredged to the required depth. The total amount of material removed from June 30th to Oct. 12th, was 199,580 cubic yards.

3. GREEN JACKET SHOAL.

The approved project contemplates the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the existing harbor lines of the city of Providence. The work of dredging under the contract with W. H. Beard of Brooklyn, N. Y., dated Nov. 18th, 1886, the time for commencement of which was extended to August 1st, 1887, and for its completion to Nov. 30th, 1887, was begun July 11th, 1887. From this time until its completion Nov. 5th, 1887, 206,431 cubic yards of material had been removed from the western end of the shoal.

4. WARREN RIVER.

In July nothing was done. Work was begun August 1st and continued until Nov. 23d, 1887, during which time 811 tons of bowlders, ledge rock and gravel were removed. The material removed was from the lower end of Little Island, excepting the Bushworth rock weighing 50 tons, which was removed from the channel opposite the lower wharves of the town. At the close of the work, the bowlders and projecting points of the ledge had been removed over an area of about 1.8 acres, extending 550 feet along the narrowest part of the channel.

Work was done by the hire of vessel and working crew in open market.

5. NEWPORT HARBOR.

The work at this point was completed as far as provided for by the appropriation of August 5th, 1886, on July 8th, 1887, by the removal of the bowlders lying in the dredged area.

The greater portion of the area to be dredged to 18 feet at mean low water, has now been completed.

6. BLOCK ISLAND HARBOR.

Work has been continued on the jetty to the west of the present breakwater under contract with Messrs. W. H. Molthrop & Co., of New London, Conn., and also in filling the gap near the outer end of the old breakwater. This work was continued on the project heretofore published. Operations for the present fiscal year began July 11th, 1887.

Work was suspended for the season on Nov. 30th, 1887, up to which time 3058 tons of stone had been placed in the gap, and 138 lineal feet of the jetty forming the shore end of the western wall of the proposed enlarged inner harbor was completed and filled with stone.

7. PAWCATUCK RIVER.

The work of dredging under contract with A. J. Beardsley & Son of Bridgeport, Conn., dated Nov. 17th, 1886, (time for completion of which was extended to Nov. 15th, 1887,) has been continued and was suspended for the season Nov. 19th, 1887. The total amount dredged during the present fiscal year was 29,414.53 cubic yards.

July 1, 1887, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1886	$11,954 75	
July 1, 1887, outstanding liabilities	2,789 08	
		14,743 83
July 1, 1887, amount available		638 16
Amount (estimated) required for completion of existing project		52,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1889		30,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging Newport Harbor, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated September 18, 1886, and opened at 12 o'clock noon, Monday, October 4, 1886.

No.	Name and address of bidder.	Price per cubic yard.	Remarks.
		Cents.	
1	Hartford Dredging Company, Hartford, Conn.	21⅞	Work to be commenced within twenty days after signing of contract, and to be finished on or before June 30, 1887.
2	W. H. Beard, Brooklyn, N. Y.	24	
3	John McDermott, Cohoes, N. Y.	24⅜	
4	Elijah Brainard, New York, N. Y.	32	
5	Richard M. Payn, Albany, N. Y.	34	
6	The Frank Pidgeon Dredging Company, New York, N. Y.	39	
7	A. B. Martin, Boston, Mass.	39	

Contract awarded to the Hartford Dredging Company, with the approval of the Chief of Engineers, and dated October 13, 1886. Time of completion extended to July 30, 1887.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

RECEIPTS OF MERCHANDISE.

Coal ... tons..	50,000	Cement ... barrels..	9,000
Shingles	5,000,000	Brick	5,000,000
Laths	8,500,000	Lumber ... feet..	12,500,000
Lime ... barrels..	18,000	Hay ... tons..	1,000
Potatoes ... bushels..	2,600	Grain ... bushels..	350,000

There are 132 vessels owned and hailing from this port, viz., 107 sail, 25 steam, the tonnage of which amounts to 6,322.03 gross, 5,051.34 net. Tonnage of the smallest vessel 2.75 gross, 2.17 net. The largest vessel draws 13 feet when loaded.

BUSINESS OF THE OLD COLONY STEAM-BOAT COMPANY FOR YEAR ENDING MAY 31, 1887.

[Furnished by Mr. George Pierce, Supervisor.]

Passengers carried between New York and Fall River, via Newport. .... No..	280,000
Merchandise, via Newport...tons..	265,000

BUSINESS OF THE NEWPORT AND WICKFORD RAILROAD AND STEAM-BOAT COMPANY FOR THE YEAR 1886.

[Furnished by Mr. C. U. Coffin, agent.]

Receipts.	Amount.
Sale of tickets........................	$50,352 25
Adams Express Company........................	1,448 96
Carrying U. S. Mail........................	8,947 56
Total........................	60,748 77

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap, which was found to let in too-much sea in stormy weather. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Vol. I, pages 612, 613.

On the 8th of December, 1884, the Senate of the United States directed that report be made of the necessity and cost of enlarging the inner harbor of refuge. The report, which was accompanied by plans and an estimate of the cost ($46,189), was printed in Senate Ex. Doc. No. 27, Forty-eighth Congress, second session, and may also be found in the Report of the Chief of Engineers for 1885, Vol. I, page 610. The commencement of this work has been approved by Congress making an appropriation of $12,000 therefor in the act of August 5, 1886.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1886

The total expenditure up to June 30, 1886, including liabilities outstanding at that date, was $324,363 88. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. In 1883 a strong jetty was built out from the cliff to the eastward of the inner harbor, and a masonry wall was constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling in the gap in the main breakwater was carried to the height of about 1½ feet above mean high water, and at the close of the work under the last contract about one-half of the total amount of stone required for the completion of this work had been delivered and placed in the gap. The sea which formerly came into the outer harbor through the gap in the main breakwater in easterly storms had been stopped by this partial filling.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. An appropriation of $20,000 having been made by the act of Congress of August 5, 1886, for enlarging the inner harbor and filling the gap in the main breakwater, advertisements were issued March 21, 1887, for furnishing rip rap granite for main breakwater, and for the commencement of the enlargement of the inner harbor in accordance with the project referred to above. The bids received and terms of the contract will be found in the appended table.

AMOUNT EXPENDED DURING LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1887.

The amount expended during the last fiscal year was $660.29. Work under the present project had not been commenced.

THE WHARF AT BLOCK ISLAND.

In his last Annual Report Col. Elliot recommended that the Government wharf on the land side of the inner harbor of refuge at Block Island should be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

> *Provided*, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town, but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

The location of this wharf may be seen in the plat published at page 618 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap to its full height of 6 feet above mean high water and its full width at top of 25 feet, and the enlargement of the inner harbor of refuge.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

It is proposed to devote the funds on hand July 1, 1887, to carrying on the filling of the gap in the main breakwater, as far as the funds provided for it will admit, and to the commencement of the enlargement of the inner harbor.

Block Island is in the Newport collection district and Newport is the nearest port of entry. The revenue collected at Newport in the last fiscal year was $2,184 51. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are four lights at the island, the north and south lights, and the breakwater lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1886, available	$636 12
Amount appropriated by act approved August 5, 1886	20,000 00
	20,636 12

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, 1889.

PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1889.

HARVARD COLLEGE
MAY 29 1917
LIBRARY

The commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.

The Board of Harbor Commissioners respectfully submits its Thirteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed J. Herbert Shedd of Providence, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

The boundary line between the city of Providence and the town of East Providence, from the Central or Red Bridge to the old Washington Bridge, was made, by act of the General Assembly, a harbor line, in March, 1866. The objects, to which the line was referred for its location, are partly destroyed and otherwise uncertain and the commissioners have, after conferences with town officers of East Providence, and with the Mayor and Engineer Department of Providence, defined the line as nearly as practicable in its original position, and made reference to the U. S. Coast Survey Stations for permanent record. They will present a plan and description of this line to you and they suggest that such location be confirmed and established as the true location of the boundary and harbor line, so far as it extends.

A petition signed by twenty-five citizens of South Kingstown asking that harbor lines be established in Washington County, is under consideration. A contention among the citizens has arisen at Narragansett Pier, on account of certain encroachments made there, and the commissioners have considered the matter of sufficient importance to order surveys of the shore from Little River to the lower pier.

A petition asking that harbor lines be established in the lower portion of Point Judith pond is under consideration. This question may be affected by the investigations now in progress by the United States Government in relation to a harbor of refuge near Point Judith.

A communication will be sent to the Governor and Senate, recommending the approval of harbor lines designed by the commissioners in Barrington river.

The Inter-State Commission appointed by Rhode Island and Connecticut to mark out lines limiting encroachments in Pawcatuck river, has not been able to complete its labors, and the matter will be made the subject of a separate report to you from the Harbor Commissioners.

ENCROACHMENTS AND DUMPING.

Continued vigilance is needed to restrain unauthorized encroachments on the public waters, and to lessen the practice of dumping ashes, etc., in places where shoaling and obstruction would result. Several obstructions have been removed, under direction of the commissioners, and others are receiving attention. The draw in the railroad bridge at India Point has been cleared to the full width of sixty feet required by law, and good lines of guide piling have been satisfactorily set.

The common dumping ground for general use is still maintained in the deep water east of Conanicut Island and south of Prudence Island, and no other dumping ground is authorized except under special permit for limited use and a stated time. A few such special permits have been granted in the past year.

OBSTRUCTIONS.

A communication was received from the Town Council of the Town of Bristol in relation to the removal of the remains of the steamer Empire State, which had been burned while lying at one of the wharves in the town. The attention of the commissioners had been previously called to obstructions caused by other wrecks of vessels and it was thought that some further legislation was desirable to provide a remedy in such cases. It was supposed that the State would not have, except by special legislation, the aid of the General Government in such matters where the wreck was within a marine league of the shore, but it appears that provision was made in the River and Harbor Act of June 14, 1880, for removal of such wrecks, and an amendment enlarging the power of the Secretary of War in such cases was inserted in the corresponding Act of August 2, 1882. The section and amendment are as follows:

"SECTION 4. Whenever hereafter the navigation of any river, lake, harbor or bay, or other navigable water of the United States, shall be obstructed or endangered by any sunken vessel or water craft, it shall be the duty of the Secretary of War, upon satisfactory information thereof, to cause reasonable notice, of not less than thirty days, to be given personally, or by publication at least once a week in the newspaper published nearest the locality of such sunken vessel or craft, to all persons interested in such vessel or craft, or in the cargo thereof, of the purpose of said secretary, unless such vessel or craft shall be removed as soon thereafter as practicable by the parties interested therein, to cause the same to be removed.

If such sunken vessel or craft and cargo shall not be removed by the parties interested therein, as soon as practicable after the date of the giving of such notice by publication, or after such personal service of notice, as the case may be, such sunken vessel or craft shall be treated as abandoned and derelict, and the Secretary of War shall proceed to remove the same. Such sunken vessel or craft and cargo, and all property therein, when so removed, shall, after reasonable notice of the time and place of sale, be sold to the highest bidder or bidders for cash; and the proceeds of such sales shall be deposited in the treasury of the United States, to the credit of a fund for the removal of such obstructions to navigation under the direction of the Secretary of War, and to be paid out for that purpose on his requisition therefor. The provisions of this act shall apply to all such wrecks, whether removed under this act or any other act of Congress. Such sum of money as may be necessary to execute this section of this act is hereby appropriated, out of any money in the treasury of the United States not otherwise appropriated, to be paid out on the requisition of the Secretary of War."

AMENDMENT IN RIVER AND HARBOR ACT OF 1882.

"The power and authority granted to the Secretary of War, under and by virtue of section four of the Act of Congress approved June 14, 1880, relating to wrecks and sunken vessels, are hereby enlarged so that the Secretary of War may, in his discretion, sell and dispose of any such sunken craft, vessel or cargo, or property therein, before the raising or removal thereof, according to the same regulations that are in said act prescribed for the sale of the same after the removal thereof; and all laws or parts of laws inconsistent herewith are hereby repealed."

Besides smaller obstructions which have been removed under direction of the commissioners two more important ones have received their attention. The Riverside wharf extending about eleven hundred feet into the bay from the easterly shore, has been abandoned and neglected, so that it has fallen into decay, while portions of it have been removed for the timber. The result is an obstruction which has caused considerable complaint to the commissioners who have endeavored to secure its complete removal, but they do not find persons who are, beyond question, responsible for its present state. The construction was originally built, for a considerable portion of its length, without authority of the General Assemby, but the work was done before a Harbor Commission was established. The commissioners do not see that they have authority to spend public money for its removal without a special appropriation therefor.

The wharf wall along the north side of the slip opposite Peck street, in Providence, now the property of Alexander Duncan, has moved from its original position, so far into the slip as to cause damage to the opposite owners. Mr. Duncan has been notified to remove all encroachments beyond the original line of the wall.

LICENSES, ETC.

Licenses have been issued as follows:

No. 89. March 16, to the New York, Providence and Boston Railroad Company, to rebuild the draw to their bridge over Warwick Cove near Oakland Beach, in the town of Warwick.

No. . April 11, to the Providence, Warren and Bristol Railroad Company, to drive piles to protect the abutments of their bridge at Bowers' Cove, in East Providence.

No. 90. May 2, to the Providence Gas Company, to rebuild their bridge, wharf and coal stores at the South Station, near Rhodes street, on the west side of Providence harbor.

No. 91. May 21, to the Attorneys for the estate of Ebben Simmons, to build a bulkhead wall, and fill with earth, across the slip next north of the Point Street Bridge, on the west side of Providence River.

No. 92. May 21, to the Rhode Island Yacht Club, to extend the wharf at their club house on the west side of the bay, near Pawtuxet.

No. 93. May 25, to John R. White & Son, to drive piles at their wharf on South Water street, between Packet and Planet streets on the east side of Providence river.

No. 94. June 27, to the Standard Oil Company, to build a sea-wall and bridge wharf, in the town of East Providence, on the east side of Pawtucket river near and south of the Red or Central Bridge.

No. 95. July 11, to J. A. Dailey & Son, to drive fender piles at the Jonathan Pike wharf, on South Water street, near Farthing street, in Providence, and to relay sea-wall.

No. 96. July 14, to the Continental Steamboat Company, to drive spring piles, for temporary use and subject to removal upon notice from this board, at the wharf of the Providence and Worcester Railroad Company, on South Water street, below James street, in Providence.

No. 97. July 25, to the Narragansett Electric Light Company, to drive piles and build a bridge wharf at their wharf on the west side of Providence river, between Elm and South streets.

No. 98. October 1, to the Providence Gas Company, to make a change in the coal elevator at their west station at the foot of Butts street, on the west side of Providence river, and to drive a pile there.

No. 99. November 22, to the Providence Institution for Savings, to drive piles and repair their wharf on South Water street, between Dollar and Dime streets, on the east side of Providence river.

No. 100. November 26, to Henry C. Clark, to drive piles and repair his wharf at the Dorrance street dock on the west side of Providence river.

No. 101. December 27, to George E. Newell, to rebuild wharf wall on the estate of Smith Grant & Company, in the city of Pawtucket.

Assent has been given as follows:

1. May 23, to George B. Burton, to drive two test piles near Red Bridge, on the east side of Pawtucket river.

2. September 12, to the Herreshoff Manufacturing Company, to extend their wharf in Bristol, eighty feet towards the channel.

3. October 24, to the New York, Providence and Boston Railroad Company, to close the draw-way to their bridge over Warwick cove near Oakland Beach, in the town of Warwick, from November 10 to January 1, 1889.

INCREASE IN AREA OF JURISDICTION.

An act was passed by the General Assembly, March 20, 1888, being Chapter 675 of the Public Laws, by which the portion of Washington County, not already covered, was placed under the jurisdiction of the Harbor Commissioners. The only territory now exempt is immediately bordering on the towns in the County of Newport and the harbors in said county.

FILLING THE COVE BASIN IN PROVIDENCE.

The Commissioners were cited to appear before the Supreme Court on the first of October to answer as defendants in the suit of Wm. G. R. Mowry, et al., to prevent the filling of the Cove Basin. Hearings have been given to counsel and to citizens in relation to the same. A communication was received from Maj. William R. Livermore, U. S. Engineers, in charge of Rhode Island waters, enclosing copies of petitions which had been sent from Rhode Island citizens to the Secretary of War, remonstrating against the filling of the Cove. The Commissioners have not taken any active part in this matter but have expressed their views upon the subject as occasion seemed to require. Acting under the advice of the Attorney General they signed affidavits to the effect that they did not desire delay in action in the matter, and they favored the filing of a demurrer.

CONGRESSIONAL CONTROL OF HARBOR LINES AND BRIDGES.

Among the powers conferred upon Congress by the Constitution is that to regulate commerce, which includes, undoubtedly, the power to regulate navigation and control the use of, and prevent obstruction in, the public navigable waters. But such power, whatever its extent, has been but little exercised. It seems to have been the practice rather, to allow the states to exercise such control as they might choose and simply withdraw appropriations for improvements where the officers of the United States considered the interference with navigation to be too great. Recently, however, a more active interest is taken in the matter of obstructions, and the River and Harbor Act of August 11, 1888, contains important sections in relation thereto.

SECTION 9. Whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed, over any of the navigable water-ways of the United States, is an obstruction to the free navigation of such waters by reason of insufficient height, width of span or otherwise, or where there is difficulty in passing the draw-opening or the raft-space of such bridge by rafts, steamboats or other water-craft, it shall be the duty of the said Secretary to give notice to the persons or corporations owning or controlling such bridge, to so alter the same as to render navigation through or under it free, easy and unobstructed; and, in giving such notice he shall prescribe in each case a reasonable time in which such alteration is to be made. If, at the end of such time, the alteration has not been made, the Secretary of War shall forthwith apprise the Attorney-General of the United States, whose duty it shall be to institute suit, in the name of the United States, without delay, in the circuit or district court of the United States for the circuit in which such bridge is located, which court is hereby invested with jurisdiction for this purpose, to recover from the owners or managers of such bridge the fines mentioned in the succeeding section of this act.

SECTION 10. The owner or owners, or manager or managers, of any railroad or other bridge, obstructing the free navigation of any navigable water-way of the United States, who shall willfully fail or refuse to remove the same, or to cause the necessary alterations to be made in the same so as to render navigation through or under it free, easy and unobstructed to rafts, steamboats or other water-craft, after receiving notice to that effect from the Secretary of War and within the time prescribed by him, shall be subject to a fine as penalty therefor of five hundred dollars per month for the time he or they are in default, and the amount so recovered shall be placed to the credit of the improvement fund of the water-way obstructed by such bridge.

The railroad bridge at India Point has been the subject of complaint by officers of the U. S. Engineer Department, as well as by citizens of Pawtucket.

The above-named Act of August 11, 1888, contains the following section:

SECTION 12. When it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors, he may and is hereby authorized to cause such lines to be established, beyond which no piers or wharves shall be extended or deposits made except under such regulations as may be prescribed from time to time by him.

It is probable that the purpose of this provision is to secure the establishment of harbor lines where none now exist. But the power of the Secretary of War may, possibly, be extended over such lines as have been established by the State for the purpose of modifying them. There seems to be good reason for a certain amount of control by the

State in such matters, and it is to be hoped that the officers representing the State and Congress, respectively, will be able to work in harmony with each other. The commissioners fully believe that this will be so for the present at least.

WORK UNDER U. S. ENGINEER.

By the courtesy of Major William R. Livermore, Corps of Engineers we have been furnished with a copy of his report to the Chief of Engineers, U. S. A., for 1888, upon the work of which he is now in charge, from which we have made extracts in relation to the work in Rhode Island waters previous to July, 1888, which will be found in the Appendix. Major Livermore has also kindly called attention to other matters and to his work in Rhode Island waters to the last of December. His communication will also be found in the Appendix.

Respectfully submitted,

J. HERBERT SHEDD,
HENRY C. BRADFORD,
WILLIAM C. CLARKE,
Harbor Commissioners.

APPENDIX.

EXTRACT FROM REPORT OF MAJOR WILLIAM R. LIVERMORE TO CHIEF OF ENGINEERS, U. S. A., FOR 1888.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay north of the harbor of Bristol. This is a new work, and no appropriation had been made for it until by act approved August 5, 1886, Congress appropriated $5,000 for the improvement of the river. In his report, January 12, 1885, of the survey made in accordance with the act of July 5, 1884, Colonel Elliott stated that the obstructions to navigation were a rocky reef below Little Island and a submerged bowlder known as Bushworth Rock near mid-channel, opposite the lower wharf of the town of Warren, and recommended that this bowlder and the reef referred to be removed as far as it could be done with an expenditure of $5,000 for both purposes.

PLANS OF IMPROVEMENT.

The work of improvement is one that can not be well carried on by contract- and the approved project is first to remove Bushworth Rock, and afterwards to remove the bowlders which lie submerged on the western side of the narrowest portion of the channel at Little Island, and also the projecting portions of the ledge beneath the bowlders, widening the channel as much as the funds available will allow; it also includes the hiring in open market of a vessel with working crew, sub-marine diver, firing battery, and steam-hoisting apparatus, and purchase of the explosives also in open market.

A plat of the river showing the proposed improvement near Little Island, was published in the Annual Report of the Chief of Engineers for 1885, page 680.

OPERATIONS DURING THE LAST FISCAL YEAR.

The work of the removal of bowlders and ledge rock, under the approved project, was commenced August 1, and continued until November 23, when the limit of the appropriation was reached. During this time 811 tons of bowlders, ledge rock, and gravel, were removed and placed on the shore.

Mr. Theo. Topham was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $4,699.39. The result was the removal of Bushworth Rock to the depth of the surrounding water, and the removal of the bowlders and points of ledge rock over an area of about 1.8 acres, in the vicinity of Little Island, extending 550 feet along the narrowest part of the channel.

WORK REQUIRED TO BE DONE TO COMPLETE THE EXISTING PROJECT.

The work carried on from August to November, 1887, finished the improvement as far as projected:

Warren River is in the Bristol-Warren collection district, which is a port of entry. There was no revenue collected in the last fiscal year. The nearest light-house is the light-house on Conimicut Point, Providence River. The nearest fortifications are fort on Dutch Island, and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1887, amount available	$4,969.50
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	4,699.39
July 1, 1888, balance available	$270.11

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which has a population of about 23,000, and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draught can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Company's Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended to June 30, 1887, was $110,969.70. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, had been carried from its mouth at the deep water just above Red Bridge, a distance of about 9,940 feet, or to a point about 2,200 feet above a line drawn from Bucklin Island to Swan Point Wharf.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of dredging under the project for the expenditure of the appropriation of $30,000 of August 5, 1886, approved by the Chief of Engineers, was in progress and was continued until October 6, when the limit of the appropriation was reached. This project contemplated the continuation of the enlarged channel as far towards Pawtucket as the funds would allow, affording at the same time such relief as the commerce may require at the shoalest places above the main work.

The amount of material dredged was 72,248.58 cubic yards. Capt. M. S. Persons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $20,160.29, and the result is the excavation of the channel about 2,800 feet up the river. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about 1¼ miles of the head of navigation.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate, by dredging, the channel 12 feet deep and 100 feet wide, from Bass Rock to a point opposite Grant & Company's Wharf and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Should an appropriation be made for this work it is proposed to extend the channel toward Pawtucket.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $240,197.75. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1887, amount available	$21,036.26
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	20,160.29
July 1, 1888, balance available	875.97
Amount appropriated by act of August 11, 1888	35,000.00
Amount available for fiscal year ending June 30, 1889	35,875.97
Amount (estimated) required for completion of existing project	367,478.00

Amount that can be profitably expended in fiscal year ending June 30, 1890	50,000.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Business Men's Association, Pawtucket, R. I.]

RECEIPTS.

Coal	tons..	150,000
Cement	barrels..	9,657
Lime	do. ..	5,628
Long lumber (about)	feet..	5,000,000
Short lumber	do. ..	1,000,000
Spool wood	do. ..	270,000

Together with large quantities of brick, iron, gravel, cotton, and various kinds of other merchandise which are used by this community.

There passed through the draw of the Washington Bridge, Pawtucket River, during the year 1887:

Steamers	684	Tow-boats	2,356
Schooners	334	Sail-boats	486
Barges	492	Miscellaneous craft	1,470

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city of about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1858, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel: first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Fields Points of the following dimensions, in cross-section, viz:

300 feet wide	25 feet deep.
600 feet wide	20 "
725 feet wide	18 "
940 feet wide	12 "
1,060 feet wide	6 "

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1887, including liabilities outstanding at that date, was $222,836.68. At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed, and the 25-foot channel, 300 feet wide, from Providence to the deep water of Narragansett Bay had been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the fiscal year the work of dredging, in that portion of the anchorage-area between Fox Point and Field's Point to be deepened to 20 feet at mean low water, was in progress and continued until October 12, when the contract was completed; up to this date 199,580 cubic yards of material had been dredged during the fiscal year.

Mr. W. C. Simmons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $19,762.92. The result was the completion of the excavation of the 20-foot anchorage-area in the Fox Point Reach, and about one-fourth of the same area in the Sassafras Point Reach. The 25-foot channel, 300 feet wide, from Fox Point in the city of Providence to the deep water of Narragansett Bay, has been completed.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage-basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Should an appropriation be made it is proposed to continue the excavation of the anchorage-area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $240,197.75. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island, and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1887, amount available	$20,763.95
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	19,762.92
July 1, 1888, balance available	1,001.03
Amount appropriated by act of August 11, 1888	40,000.00
Amount available for fiscal year ending June 30, 1889	41,001.03
Amount (estimated) required for completion of existing project	165,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1890	100,000.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

RECEIPTS.

Articles.	Quantity.	Articles.	Quantity.
Lumber ... feet	3,736,000	Shingles	3,132,000
Laths	7,974,000	Pickets	9,080
Piling ... pieces	150	Wood ... cords	3,921
Salt ... pounds	7,350,749	Logwood ... tons	4,082
Brimstone ... tons	630	Potatoes ... bushels	36,950
Starch ... casks	738	Clapboards	5,400
Cliffstone ... tons	1,050	Brandy ... gallons	4,597
Champagne ... baskets	328	Beer ... do	919
Cotton ... bales	200,607	Beef ... tons	8,349
Wool ... do	61,207	Flour ... barrels	244,381
Do ... sacks	39,516	Corn ... bushels	1,614,291
Do ... pounds	5,103,371	Oats ... do	1,278,738
Coal ... tons	887,424	Dry goods ... cases	59,766
Iron and steel ... do	26,308	Paper ... tons	3,341
Lumber ... feet	49,088,910	Chemicals ... packages	71,666
Oil ... barrels	155,844	Hardware ... tons	2,438
Waste ... pounds	11,039,881	Liquor ... barrels	20,276

TONNAGE.

Vessels.	No.	Tonnage.
Sail	87	15,254.48
Steam	35	16,884.95

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, R. I.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long, by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side a width of 300 feet and a depth of 20 feet, and the one on the south side a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal, with report of survey, was published in the Annual Report of the Chief of Engineers for 1885, vol. 1, pages 598-602.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended, including outstanding liabilities to June 30, 1887, was $767.47. At the close of the last fiscal year the work of dredging had not commenced.

OPERATIONS DURING THE LAST FISCAL YEAR.

The work of dredging under the approved project was commenced July 11, and continued until November 5, when the contract was completed. Two hundred and six thousand four hundred and thirty-one cubic yards of material were excavated.

Mr. W. C. Simmons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended, including outstanding liabilities, to June 30, 1888, was $24,388.13. The result was the excavation to a depth of 25 feet at mean low water of an area of about 9¼ acres, extending along the western side of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract was from 3 to 4 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Should an appropriation be made for this work it is proposed to continue the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $240,197.75. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

COMMERCIAL STATISTICS.

For the commercial statistics, see report of the improvement of Providence River and Narragansett Bay, Rhode Island.

MONEY STATEMENT.

July 1, 1887, amount available	$25,482.53
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	24,388.13
July 1, 1888, balance available	1,094.40
Amount appropriated by act of August 11, 1888	28,000.00
Amount available for fiscal year ending June 30, 1889	29,094.40
Amount (estimated) required for completion of existing project	58,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1890	50,000.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications under which we are now working are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin ; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north ; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor ; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Vol. 1, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended up to the close of the fiscal year ending June 30, 1887, including liabilities outstanding at that date, was $107,563.87, with the following results:

Of the area to be dredged to 13 feet within the harbor, about nine-tenths had been completed, except at a few places in the northern part of the harbor, where the material was found too hard for the dredge in use at the time. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The increase of width to be made between the 15-foot curves at the southern entrance, by dredging the spit south of Goat Island, had been completed. The berth for vessels at the Quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of dredging in the 13-foot anchorage area under the contract with the Hartford Dredging Company, described in the last Annual Report of the Chief of Engineers, was in progress and was completed July 8.

Mr. Theo. Topham was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $560.36, and the result was the completion of the excavation of about nine-tenths of the 13-foot anchorage area. Of the total area to be dredged within the harbor (about 90 acres) about two-thirds have been completed. The berths for vessels at the Quartermaster's wharf at Fort Adams was deepened to 10 feet at mean low water, and the effectual stopping for the present of the supply of littoral sand and gravel from the outside of Goat Island into the southern entrance by the jetty on the southwest shore of the island. The southern entrance is completed for vessels of 15 feet draught.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island spit; the remainder of the excavation within the harbor of the anchorage area of 13 feet depth, and the excavation also within the harbor of the anchorage area of 10 feet depth ; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Should any appropriation be made for this work it is proposed to complete the 15-foot channel as projected and extend the anchorage area as far as possible to the east and south.

Newport is in the collection district of Newport and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $4,774.26. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1887, amount available	$638.16
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	560.36
July 1, 1888, balance available	77.80
Amount appropriated by act of August 11, 1888	12,000.00
Amount available for fiscal year ending June 30, 1889	12,077,80
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1890	30,000.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs, 1887.]

RECEIPTS OF MERCHANDISE.

Articles.	Quantity.	Articles.	Quantity.
Coal ... tons..	50,000	Cement ... barrels..	9,000
Shingles	5,000,000	Brick	5,000,000
Laths	8,500,000	Lumber ... feet..	12,500,000
Lime ... barrels..	13,000	Hay ... tons..	1,000
Potatoes ... bushels..	2,600	Grain ... bushels..	350,000

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island. It is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORKS.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed with the exception of an opening 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and the enlargement of the inner harbor. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The total expenditure up to June 30, 1887, including liabilities outstanding at that date, was $325,024.17. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In the stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. In 1883 a strong jetty was built out from the cliff to the eastward of the inner harbor, and a masonry wall was constructed on the inside of the crib-work, forming the eastern side of the inner harbor.

The filling in the gap in the main breakwater was carried to the height of about 1½ feet above mean high water, and at the close of the work under the last contract, about one-half of the total amount of stone required for the completion of this work had been delivered and placed in the gap. The sea, which formerly came into the outer harbor through the gap in the main breakwater in easterly storms, had been stopped by this partial filling. A contract for the commencement of the enlargement of the inner harbor and filling the gap in the main breakwater was made.

OPERATIONS DURING THE LAST FISCAL YEAR.

The work of the commencement of the enlargement of the inner harbor and filling the gap in the main breakwater, provided for in the appropriation of August 5, 1886, was commenced July 11, 1887, and continued until November 30, when it was suspended for the winter; it was resumed April 17, 1888, and continued to the end of the fiscal year. There were 4,258 tons of riprap granite placed in the gap of the main breakwater, which carried that portion of the work as far as the funds available would allow. The timber jetty filled with stone, to form the shore end of the west wall of the proposed enlarged harbor, was built from high water to low water of spring tides, a distance of 138 feet, and a substantial enrockment placed at its outer end to protect it from the action of the sea until the west wall is built.

The work of the construction of the north wall of the inner harbor was commenced near the breakwater, from whence it will be carried to the westward as far as the available funds will permit. At the close of the fiscal year the work was still in progress. Mr. Frank I. Angell was the local inspector of the work.

In response to a resolution of the Senate of the United States, passed April 17, 1888, calling for an estimate of the cost of the removal of a shoal obstructing navigation at the entrance to the harbor of Block Island, the following report was submitted to the Chief of Engineers, on May 4:

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., May 4, 1888.

SIR: Referring to the letter of the Chief of Engineers of April 18, 1888, inclosing a copy of a resolution of the Senate asking for an estimate of the cost of removing a sand-bar which has recently formed, obstructing navigation, at the entrance of the harbor at Block Island, I have the honor to report that a gradual shoaling along the western side of the breakwater has taken place for a number of years; this reaches its maximum width at the point where the north wall of the proposed enlarged harbor joins the main breakwater, and since the survey of 1884 the 9-foot curve has advanced to the westward about 70 feet,

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel: first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage-basin between Fox and Fields Points of the following dimensions, in cross-section, viz:

300 feet wide	25 feet deep.
600 feet wide	20 "
725 feet wide	18 "
940 feet wide	12 "
1,060 feet wide	6 "

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1887, including liabilities outstanding at that date, was $222,836.68. At that date about one-half of the excavation required for the anchorage-basin above Field's Point had been done. Bulkhead Rock had been removed, and the 25-foot channel, 300 feet wide, from Providence to the deep water of Narragansett Bay had been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the fiscal year the work of dredging, in that portion of the anchorage-area between Fox Point and Field's Point to be deepened to 20 feet at mean low water, was in progress and continued until October 12, when the contract was completed; up to this date 199,580 cubic yards of material had been dredged during the fiscal year.

Mr. W. C. Simmons was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $19,762.92. The result was the completion of the excavation of the 20-foot anchorage-area in the Fox Point Reach, and about one-fourth of the same area in the Sassafras Point Reach. The 25-foot channel, 300 feet wide, from Fox Point in the city of Providence to the deep water of Narragansett Bay, has been completed.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage-basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Should an appropriation be made it is proposed to continue the excavation of the anchorage-area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $240,197.75. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island, and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1887, amount available	$20,763.95
July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	19,762.92
July 1, 1888, balance available	1,001.03
Amount appropriated by act of August 11, 1888	40,000.00
Amount available for fiscal year ending June 30, 1889	41,001.03
Amount (estimated) required for completion of existing project	165,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1890	100,000.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1¼ feet at mean low water.

PLANS OF IMPROVEMENT.

By means of appropriations made in the years 1871-'75 the river was improved by the United States by the excavation of a channel 5¼ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging-machine, or about 40 feet, between the lower and the upper wharves; also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, part 1, pages 623-625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1887.

The amount expended on the present project to June 30, 1887, including outstanding liabilities, was $3,535.12, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to Certain Draw Point.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the fiscal year the work of dredging under the project for the expenditure of the appropriation of August 5, 1886, which contemplated the beginning of the channel at the deep water opposite the village of Lottery and extending it as far towards Westerly as the funds would allow, was in progress and was continued until November 19, when it was suspended for the winter ; it was resumed April 24 and continued until the close of the fiscal year, when it was still in progress.

During the fiscal year 48,938.8 cubic yards of sand and mud and 8.32 cubic yards of bowlders over 2 tons weight were excavated from the channel.

Mr. A. H. Dickens was the local inspector of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1888.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1888, was $6,928.50, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the lower end of Major's Island, with the exception of a small amount of ledge rock which extends into the channel near Certain Draw Point and at Pawcatuck Rock.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water, and width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town ; also the removal of the ledge rock near Certain Draw Point and Pawcatuck Rock.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

It is proposed to continue the work of widening and deepening the channel according to the new project as far toward Westerly as the funds will admit, and also to afford such relief as the commerce of the river may require at the shoalest places in advance of the main work, and to remove the points of ledge rock referred to above.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was : Providence, $240,197.75 ; Stonington, $1,659.18. The nearest light-houses are the Stonington and Watch Hill Lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1887, amount available....	$8,464.88

July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1887	$5,184.13	
July 1, 1888, outstanding liabilities	1,744.37	
July 1, 1888, amount covered by existing contracts	1,137.38	
		8,065.88
July 1, 1888, balance available		399.00
Amount appropriated by act of August 11, 1888		10,000.00
Amount available for fiscal year ending June 30, 1889		10,399.00
Amount (estimated) required for completion of existing project		16,637.00
Amount that can be profitably expended in fiscal year ending June 30, 1890		16,637.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxon & Co., Westerly, R. I.]

RECEIPTS AT WESTERLY BY WATER.

Coal	tons	18,540
Molding sand	do	547
Lumber	feet	5,309,790
Bricks		359,000
Grain	bushels	94,000

SHIPMENTS.

Stone	tons	2,350
Number of passengers carried by steamers		54,400

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., March 29, 1889.

Hon. J. Herbert Shedd, Chairman Board of Harbor Commissioners, Providence, R. I.

SIR—Your letter of March 26, asking for a copy of my last annual report to the Chief of Engineers, and for a resumé of the work under this office in Rhode Island waters to the last of December, has been received.

Herewith please find three copies of Appendix C. of the annual report of the Chief of Engineers for 1888, containing the report referred to.

In regard to the work between the beginning of the present fiscal year and the last of December, the following extract is made from the River and Harbor Act of August 11, 1888 :

"SEC. 18. That the Secretary of War is hereby directed at his discretion to cause examinations or surveys, or both, to be made, and the cost of improvement to be estimated at the following localities, to wit : In the States of

* * * * * * * * * *

RHODE ISLAND.

Fishing Place Cove, near Sakonnet Point, with a view to constructing a breakwater.

Cove near southeast extremity of Coaster's Harbor Island, and water way between said island and Rhode Island, with a view to deepening the water-way and removing obstructions.

Entrance to Point Judith Pond, west of Point Judith with a view to establishing a harbor of refuge.

Coast near Life Saving Station, East Point Judith, with a view to constructing a breakwater.

Greenwich Bay, to deepen bar on Long Point.

For a survey of Narragansett Bay, at the mouth of Narrow River, with a view of constructing a breakwater.

* * * * * * * * * *

"SEC. 14. For examinations, surveys and contingencies * * * * one hundred and fifty thousand dollars : Provided, that no survey shall be made of any harbors or rivers until the Chief of Engineers shall have directed a preliminary examination of the same by the local engineer in charge of the district, or an engineer detailed for the purpose ; and such local or detailed engineer shall report to said Chief of Engineers, whether, in his opinion, said harbor or river is worthy of improvement, and shall state in such report fully and particularly the facts and reasons on which he bases such opinion, including the present and prospective demands of commerce ; and it shall be the duty of the Chief of Engineers to direct the making of such survey, if, in his opinion, the harbor or river proposed to be surveyed be worthy of improvement by the General Government ; and he shall report to the Secretary of War the facts, and what public necessity or convenience may be subserved thereby, together with the full reports of the local engineer : *And provided further,* That the Government shall not be deemed to have entered upon any project for the construction or improvement of any waterway, harbor or canal mentioned in this act unless or until the work of construction shall have been actually appropriated for. Said reports of preliminary examinations and surveys shall be made to the House of Representatives, and are hereby ordered to be printed when so made."

In compliance with the above provisions preliminary examinations have been made at the above points and the reports submitted to the Chief of Engineers; these have not as yet been published.

The north wall of the enlarged inner harbor at Block Island was built out to a point 466 feet from the breakwater. Very respectfully,

W. R. LIVERMORE,

Major of Engineers.

Eng 1010.37

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, 1890.

PROVIDENCE:
E. L. FREEMAN & SON, STATE PRINTERS.
1890.

State of Rhode Island and Providence Plantations.

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E. L. FREEMAN & SON, STATE PRINTERS.
1890.

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The Commissioners,

REPORT.

To the Honorable the General Assembly of the State of Rhode Island.

The Board of Harbor Commissioners respectfully submits its Fourteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed Henry C. Bradford, of Providence, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

The boundary and harbor line between Providence and East Providence from the Red Bridge to near the old Washington Bridge, has been adopted by the Harbor Commissioners but no action in confirmation thereof has been taken by the General Assembly.

A harber line in Barrington river designed by a former commission has been approved by the present board and will be presented for final action at this session.

In response to a petition a survey has been made of the west shore of Narragansett Bay, from near Sanderstown to near Bonnett Point, with a view to the establishment of a harbor line.

Citizens of the District of Narragansett have taken much interest in the proposed establishment of a harbor line from near Narrow river, north of the bathing beach, southerly along the shore to below the lower pier. Interviews have been had between the commissioners and the District Council, and also with private citizens, and an advertised hearing was held in Providence on November 25, which was well attended, but at which the wish was generally expressed that a hearing be held at Narragansett Pier. After due advertisement a public hearing was held accordingly on December 28. After all parties had been heard the matter was left open for further suggestions from parties in interest.

In view of the hoped for improvement of the outlet of Point Judith Pond by the U. S. Government, riparian owners petitioned for the establishment of harbor lines in the southern portion of the pond. After due consideration the commissioners assented to devise harbor lines provided the cost of surveys and plans be borne by the parties in interest. This was done, and a duly advertised hearing was held in Providence, December 27. Some opposition was developed at this hearing, and the matter was held for further consideration by the commissioners.

ENCROACHMENT AND DUMPING.

The importance of a continual watch over the public waters of the State, that no accidental or unauthorized obstructions shall be permitted to interfere with their proper use, is constantly apparent. Many matters have received attention under these heads during the year.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters to the number of thirteen, as follows:

No. 102. February 9, to George Gerhard, to drive piles and build a wharf for Chas. Pay, 2d, on South Water street, near Sovereign street, in Providence.

No. 103. February 13, to Henry C. Clark, to drive piles and repair walls of wharves on both sides of slip, at foot of Orange street, in Providence.

No. 104. March 18, to Joseph Provuncher, to drive five spring piles at his boat yard on the east side of Seekonk river, in East Providence.

No. 105. March 18, to George Gerhard, to drive piles and extend bridge wharf on the east side of Seekonk river, opposite his lot in East Providence.

No. 106. March 20, to F. A. Cranston, to repair wharf and drive piles on his estate between Patriot and Dubloon streets, and abutting on South Water street, in Providence.

No. 107. April 3, to the Shore Transportation Company, to drive fifty piles or less at wharf on South Water street, next south of Crawford street, in Providence.

No. 108. April 3, to the Providence and Stonington Steamship Company, to drive piles and repair wharf at Fox Point, in Providence.

No. 109. April 24, to Charles Frazer & Son, to build a bridge wharf on the east side of the Seekonk river, between Washington and India bridges, in East Providence.

No. 110. May 27, to F. A. Cranston, to drive eight piles along the front line of his warf on South Water street, between Dubloon and Patriot streets, in Providence.

No. 111. May 27, to William Gregory, Treasurer of St. Paul's Guild, of North Kingstown, to build a sea-wall in tidewater adjoining land owned by said Guild, above the bridge in the village of Wickford.

No. 112. May 28, to A. L. Mason and B. Buffum, to build a bridge wharf from east end of Ocean street, Pawtuxet, in the town of Cranston, to the harbor line.

No. 114. November 6, to George A. Manchester, Agent for the Old Colony Railroad Company, to rebuild said Company's wharf, at "Barrington Yard," in East Providence.

No. 115. December 18, to the Town Council of the Town of Bristol, to build a retaining wall across the dock at the foot of State street, and fill to the same.

Assent has been given as follows:

1. June 19, to Joseph Dews, to extend and improve his wharves at East Greenwich.

2. June 19, to George H. Remington and John T. Henthorn, to build a bridge wharf at River View.

WORK UNDER U. S. ENGINEER.

By the courtesy of Major William R. Livermore, Corps of Engineers, we have been furnished with a copy of his report to the Chief of Engineers, U. S. A., for 1889, upon the work of which he is now in charge, from which we have made extracts in relation to the work in Rhode Island waters, which will be found in the appendix.

Respectfully submitted,

J. HERBERT SHEDD,
H. C. BRADFORD,
WM. C. CLARKE,
Harbor Commissioners.

APPENDIX.

EXTRACT FROM REPORT OF MAJOR WILLIAM R. LIVERMORE TO CHIEF OF ENGINEERS, U. S. A., FOR 1889.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay, north of the harbor of Bristol. The obstructions to navigation were a rocky reef below Little Island, and a submerged bowlder, known as Bushworth Rock, near mid-channel, opposite the lower wharf of the town of Warren. By act approved August 5, 1886, Congress appropriated $5,000 for the improvement of the river, and with this sum it was proposed that the bowlder and reef referred to be removed as far as possible.

PLANS OF IMPROVEMENT.

The work of improvement was one that could not be well carried on by contract, and the approved project was first to remove Bushworth Rock, and afterwards to remove the bowlders which lay submerged on the western side of the narrowest portion of the channel at Little Island, and also the projecting portions of the ledge beneath the bowlders, widening the channel as much as the funds available permitted ; it also included the hiring in open market of a vessel with working crew, sub-marine diver, firing battery, and steam hoisting apparatus, and purchase of the explosives also in open market.

A plat of the river, showing the proposed improvement near Little Island, was published in the Annual Report of the Chief of Engineers for 1885, page 630.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended to June 30, 1888, including liabilities outstanding at that date, was $4,699.39. The result was the removal of Bushworth Rock to the depth of the surrounding water, and the removal of the bowlders and points of

1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $260,813.27. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$1,094 40
Amount appropriated by act of August 11, 1888		28,000 00
		$29,094 40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$2,764 94	
July 1, 1889, outstanding liabilities	143 83	
		2,908 77
July 1, 1889, balance available		26,185 63
Amount (estimated) required for completion of existing project		58,096 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		50,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for removal of Green Jacket Shoal, Providence Harbor, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1889.*

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889].

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging per cubic yard.*
			Cents.
†1	Atlantic Dredging Company, New York, N. Y.	$25 14	
†2	W. H. Beard, Brooklyn, N. Y.		.15
†3	Brainard Bros., New York, N. Y.		.17

* Measured in scows. † Informal.

Abstract of proposals for removal of Green Jacket Shoal, Providence Harbor, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23rd of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging per cubic yard.*
			Cents.
1	Atlantic Dredging Company, New York, N. Y.		16⅞
†1	W. H. Beard, Brooklyn, N. Y.		17⅛

* Measured in place. † Informal.

COMMERCIAL STATISTICS.

For the commercial statistics, see report of the improvement of Providence River and Narragansett Bay, Rhode Island.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during the summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications, under which we are now working, are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, vol. 1, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was $108,124 23, with the following results:

Of the area to be dredged to 13 feet within the harbor, about nine-tenths had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draught, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds have been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated $12,000 for continuing the improvement. A project for expending this sum was accordingly prepared and was approved by the Chief of Engineers. The project contemplates first the completion of the 15-foot channel by dredging along its western edge north of the dolphin; second, the completion of the dredging of the 13-foot anchorage area; and third, if the funds permit, the commencement of the 10-foot anchorage area, all of which areas are within the harbor, and, if it becomes necessary, the construction of an additional jetty on the western shore of Goat Island.

Advertisements for proposals for dredging under this project were published December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications, and the prices bid were excessive. All the proposals were rejected, and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. An abstract of the proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island Spit; the remainder of the excavation within the harbor of the anchorage area of 13 feet depth, and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to complete the 15-foot channel as projected, and extend the anchorage area as far as possible to the east and south.

Newport is in the collection district of Newport and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,901.89. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$77 80
Amount appropriated by act of August 11, 1888		12,000 00
		$12,077 80
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$1,200 65	
July 1, 1889, outstanding liabilities	164 33	
		1,364 98
July 1, 1889, balance available		$10,712 82
Amount (estimated) required for completion of existing project		$40,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		30,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock, noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
			Cents.
†1	J. H. Fenner, Jersey City, N. J.	....	34⅛
†2	W. H. Beard, Brooklyn, N. Y.	....	35
†3	Brainard Bros., New York, N. Y.	....	35¾

* Measured in scows. † Informal.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock, noon, on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
			Cents.
†1	W. H. Beard, Brooklyn, N. Y.	$0 41⅙	....
2	Hartford Dredging Co., Hartford, Conn.	10 00	43
3	Brainard Bros., New York, N. Y.	....	43

* Measured in place. † Informal.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $260,813.27. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$1,001 03
Amount appropriated by act of August 11, 1888		40,000 00
		$41,001 03
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$4,235 35	
July 1, 1889, outstanding liabilities	48 41	
		$4,283 76
July 1, 1888, balance available		$36,717 27
Amount (estimated) required for completion of existing project		$165,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		100,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening of 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and restoring the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of a shoal along the western side of the breakwater. A plat of Block Island, showing the postion of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The total expenditure up to June 30, 1888, including liabilities outstanding at that date, was $339,008.72. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been carried to an extent sufficient to keep out the sea which was formerly driven through it into the outer harbor in easterly storms. The timber jetty filled with stone forming the shore end of the western wall of the enlarged inner harbor had been finished, and the construction of its north wall had been commenced.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year operations were in progress under a contract with William H. Molthrop & Co., which was described in the Annual Report of the Chief of Engineers for 1887, and were continued until the early part of November, 1888, when work was suspended by reason of bad weather. It was resumed in February, 1889, and completed as far as the funds applicable to this contract permitted. Three thousand five hundred and thirty tons of riprap granite were placed in the north wall of the inner harbor during the fiscal year. Mr. F. I. Angell was local inspector of the work.

By act of August 11, 1888, Congress appropriated the following amounts for continuing the improvement of this harbor: Four thousand dollars for the breakwater, $6,000 for the inner harbor, and $5,000 for removing sand-bar at the entrance to the harbor. A project for the application of these funds was accordingly prepared and was approved by the Chief of Engineers. The project contemplates the completion of the filling of the gap in the main breakwater and the restoration of the breakwater to its original dimensions, the continuation of the construction of the riprap walls of the enlarged harbor, and the removal, by dredging, of the shoal extending along the western side of the breakwater. Advertisements for proposals for carrying on the work at Block Island were published, as follows:

April 3, 1889, for dredging; proposals to be opened May 3, 1889. April 3, 1889, for riprap granite for the inner harbor, and April 15, 1889, for riprap granite and chip-stone for the breakwater to be opened May 3 and 15, 1889, respectively. No proposals were received for the dredging. One bid for the inner harbor work and one for the breakwater were received. Both were rejected as excessive.

Arrangements for continuing the work by hire of labor and purchase or hire of plant in open market were in progress at the close of the fiscal year.

THE WHARF AT BLOCK ISLAND.

In the annual reports of the officer in charge for some years past attention has been called to the dilapidated and dangerous condition of the wharf. It is on the land side of the inner harbor and was built by the United States for purposes of construction of that work. Since completion of the inner harbor the only use of the wharf by the Government has been for the purpose of landing mails and supplies for the light-houses, etc. This use it is thought does not warrant an estimate for its repair or reconstruction, which would cost perhaps $2,500.

In his annual report for the year 1886, Colonel Elliot, for reasons which were fully set forth, recommended that this wharf be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

Provided, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

During the past year the wharf has been temporarily repaired by the citizens of Block Island at their own expense. The location of the wharf may be seen in the plat published at page 613 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of the sand bar formed along the western side of the breakwater.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to apply the amount available July 1, 1889, to the continuation of the work, according to the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport in the last fiscal year was $2,901.89. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$776 79
Amount appropriated by act of August 11, 1888		15,000 00
		$15,776 79
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$1,892 67	
July 1, 1889, outstanding liabilities	30 00	
		$1,922 67
July 1, 1889, balance available		
Breakwater	$3,633 78	
Inner harbor	5,295 43	
Removing sand-bar	4,924 91	
		13,854 12

Amount (estimated) required for completion of existing project......	$80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1891..........	30,000 000

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing and placing riprap granite in the north wall of the inner harbor at Block Island, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 3, 1889, and opened at 12 o'clock, noon, on Friday, the 3d day of May, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before Sept. 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn.............................	$1 72

Abstract of proposals for furnishing and placing riprap granite and chip stone on the breakwater at Block Island, R. I., received at Engineer office, U. S. Army, Newport, R. I., in response to advertisement dated April 15, 1889, and opened at 12 o'clock, noon, on Wednesday, the 15th day of May, 1889.

[Work to be commenced on or before July 15, 1889, and completed on or before Oct. 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn.............................	$1.96

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Report on the arrival and departure of steam and sailing vessels, together with imports and exports, to and from Block Island for the year ending December 31, 1888.

Coal received (about)...	tons,	5,500
Iron received (about)...	"	275
Grain received (about).........	bushels,	15,500

Lumber received (about)....................................feet,	4,300,000
General Merchandise, not included in the above, imported and exported, tons......	15,500

ARRIVALS AND DEPARTURES FOR THE YEAR.

Steamers from 50 to 1,000 tons, drawing from 8 to 10 feet of water....	2,200
Sailing vessels, from 10 to 200 tons, from 2 to 6 feet draught (about)...	116,000

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water.

PLANS OF IMPROVEMENT.

By means of appropriations made in the years 1871–'75, the river was improved by the United States by the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging-machine, or about 40 feet between the lower and the upper wharves, also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel-lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, Part I, pages 623–625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on the present project up to June 30, 1888, including outstanding liabilities, was $10,463.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the lower end of Major's Island, with the exception of small amounts of ledge rock which extend into the channel near Certain Draw Point and at Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of dredging under the contract with A. J. Beardsley & Son, which was described in the Annual Report of the Chief of Engineers for 1887, was in progress and was continued until August 4, 1888, when the funds available for the work were exhausted.

During the fiscal year 8,355.6 cubic yards of material, mainly sand and gravel, and 5.92 cubic yards of bowlders over 2 tons weight were excavated from the channel.

Mr. A. H. Dickens was the local inspector of the work

By act of August 11, 1888, Congress appropriated $10,000 for continuing the improvement. A project for the expenditure of this sum was accordingly prepared and was approved by the Chief of Engineers. This project contemplates extending the channel from the upper end of the work under the last contract towards Westerly as far as the funds will permit, and the removing of such small areas of ledge rock as may be uncovered by dredging, and affording such relief as the commerce may require at the shoalest places above the main work.

Advertisements for proposals for dredging under this project were published December 8, 1888. One proposal was received and was opened January 8, 1889. It was not made in accordance with the specifications, and the price bid was excessive. The proposal, therefore, was rejected and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected Abstracts of the proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town; also the removal of the ledge rock near Certain Draw Point and Pawcatuck Rock.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the work of widening and deepening the channel, according to the new project, as far toward Westerly as the funds will admit, and also to afford such relief as the commerce of the river may require at the shoalest places in advance of the main work, and to remove the points of ledge rock referred to above.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $260,818.27; Stonington, $1,375.50. The nearest light houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1888, amount available		$399 00
Amount appropriated by act of August 11, 1888		10,000 00
		10,399 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$789 77	
July 1, 1889, outstanding liabilities	35 38	
		825 15
July 1, 1889, balance available		9,573 85
Amount (estimated) required for completion of existing project		16,637 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		16,637 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island Spit; the remainder of the excavation within the harbor of the anchorage area of 18 feet depth, and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to complete the 15-foot channel as projected, and extend the anchorage area as far as possible to the east and south.

Newport is in the collection district of Newport and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,901.89. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$77 80
Amount appropriated by act of August 11, 1888		12,000 00
		$12,077 80
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$1,200 65	
July 1, 1889, outstanding liabilities	164 33	
		1,364 98
July 1, 1889, balance available		$10,712 82
Amount (estimated) required for completion of existing project		$40,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		30,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock, noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
			Cents.
†1	J. H. Fenner, Jersey City, N. J.	....	34⅛
†2	W. H. Beard, Brooklyn, N. Y.	....	35
†3	Brainard Bros., New York, N. Y.	....	35¾

* Measured in scows. † Informal.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock, noon, on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
			Cents.
†1	W. H. Beard, Brooklyn, N. Y.	$0 41⅛	....
2	Hartford Dredging Co., Hartford, Conn.	10 00	43
3	Brainard Bros., New York, N. Y.	....	43

* Measured in place. † Informal.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

RECEIPTS YEAR ENDING JUNE 30, 1889.

Articles.	Quantity.	Articles.	Quantity.
Spruce plank and boards.....feet..	890,000	Lime............................bbls..	17,000
Shingles....................................	7,036,000	Cement.......................... "..	13,000
Hemlock boards..........................	271,000	Brick..	9,000,000
Pine boards................................	26,600	Lumber ....feet..	14,000,000
Laths...	10,353,400	Hay.............. ....tons..	1,500
Coal......... ....tons..	50,000	Grain......................bushels..	40,000

During the year about five thousand vessels of all classes have arrived at this port. Of these twenty-nine entered from foreign ports, and discharged cargoes valued at $16,271.92. There are one hundred and forty-three vessels owned and hailing from this port, viz.: one hundred and thirteen sail, thirty steam, the tonnage of which is 7,694.54 gross, 6,251.60 net. The tonnage of the largest vessel enrolled at this port is 728.75 gross, 718.68 net, and draws when loaded about 13 feet; the tonnage of the smallest licensed vessel is 2.75 gross, 2.17 net.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 800 feet in area, and inclosed, with the exception of an opening of 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 800 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and restoring the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of a shoal along the western side of the breakwater. A plat of Block Island, showing the postion of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The total expenditure up to June 30, 1888, including liabilities outstanding at that date, was $389,008.72. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been carried to an extent sufficient to keep out the sea which was formerly driven through it into the outer harbor in easterly storms. The timber jetty filled with stone forming the shore end of the western wall of the enlarged inner harbor had been finished, and the construction of its north wall had been commenced.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year operations were in progress under a contract with William H. Molthrop & Co., which was described in the Annual Report of the Chief of Engineers for 1887, and were continued until the early part of November, 1888, when work was suspended by reason of bad weather. It was resumed in February, 1889, and completed as far as the funds applicable to this contract permitted. Three thousand five hundred and thirty tons of riprap granite were placed in the north wall of the inner harbor during the fiscal year. Mr. F. I. Angell was local inspector of the work.

By act of August 11, 1888, Congress appropriated the following amounts for continuing the improvement of this harbor: Four thousand dollars for the breakwater, $6,000 for the inner harbor, and $5,000 for removing sand-bar at the entrance to the harbor. A project for the application of these funds was accordingly prepared and was approved by the Chief of Engineers. The project contemplates the completion of the filling of the gap in the main breakwater and the restoration of the breakwater to its original dimensions, the continuation of the construction of the riprap walls of the enlarged harbor, and the removal, by dredging, of the shoal extending along the western side of the breakwater. Advertisements for proposals for carrying on the work at Block Island were published, as follows:

April 3, 1889, for dredging; proposals to be opened May 3, 1889. April 3, 1889, for riprap granite for the inner harbor, and April 15, 1889, for riprap granite and chip-stone for the breakwater to be opened May 3 and 15, 1889, respectively. No proposals were received for the dredging. One bid for the inner harbor work and one for the breakwater were received. Both were rejected as excessive.

Arrangements for continuing the work by hire of labor and purchase or hire of plant in open market were in progress at the close of the fiscal year.

THE WHARF AT BLOCK ISLAND.

In the annual reports of the officer in charge for some years past attention has been called to the dilapidated and dangerous condition of the wharf. It is on the land side of the inner harbor and was built by the United States for purposes of construction of that work. Since completion of the inner harbor the only use of the wharf by the Government has been for the purpose of landing mails and supplies for the light-houses, etc. This use it is thought does not warrant an estimate for its repair or reconstruction, which would cost perhaps $2,500.

In his annual report for the year 1886, Colonel Elliot, for reasons which were fully set forth, recommended that this wharf be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

Provided, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

During the past year the wharf has been temporarily repaired by the citizens of Block Island at their own expense. The location of the wharf may be seen in the plat published at page 613 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of the sand bar formed along the western side of the breakwater.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to apply the amount available July 1, 1889, to the continuation of the work, according to the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport in the last fiscal year was $2,901.89. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1888, amount available		$776 79
Amount appropriated by act of August 11, 1888		15,000 00
		$15,776 79
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$1,892 67	
July 1, 1889, outstanding liabilities	30 00	
		$1,922 67
July 1, 1889, balance available		
Breakwater	$3,633 78	
Inner harbor	5,295 43	
Removing sand-bar	4,924 91	
		13,854 12

Amount (estimated) required for completion of existing project......	$30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1891..........	30,000 000

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing and placing riprap granite in the north wall of the inner harbor at Block Island, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 3, 1889, and opened at 12 o'clock, noon, on Friday, the 3d day of May, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before Sept. 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn..............................	$1 72

Abstract of proposals for furnishing and placing riprap granite and chip stone on the breakwater at Block Island, R. I., received at Engineer office, U. S. Army, Newport, R. I., in response to advertisement dated April 15, 1889, and opened at 12 o'clock, noon, on Wednesday, the 15th day of May, 1889.

[Work to be commenced on or before July 15, 1889, and completed on or before Oct. 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn..............................	$1.96

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Report on the arrival and departure of steam and sailing vessels, together with imports and exports, to and from Block Island for the year ending December 31, 1888.

Coal received (about)..	tons,	5,500
Iron received (about)..	"	275
Grain received (about).........	bushels,	15,500

Lumber received (about)	feet, 4,300,000
General Merchandise, not included in the above, imported and exported, tons	15,500

ARRIVALS AND DEPARTURES FOR THE YEAR.

Steamers from 50 to 1,000 tons, drawing from 3 to 10 feet of water	2,200
Sailing vessels, from 10 to 200 tons, from 2 to 6 feet draught (about)	116,000

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water.

PLANS OF IMPROVEMENT.

By means of appropriations made in the years 1871–'75, the river was improved by the United States by the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging-machine, or about 40 feet between the lower and the upper wharves, also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel-lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, Part I, pages 623–625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on the present project up to June 30, 1888, including outstanding liabilities, was $10,463.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the lower end of Major's Island, with the exception of small amounts of ledge rock which extend into the channel near Certain Draw Point and at Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of dredging under the contract with A. J. Beardsley & Son, which was described in the Annual Report of the Chief of Engineers for 1887, was in progress and was continued until August 4, 1888, when the funds available for the work were exhausted.

During the fiscal year 8,355.6 cubic yards of material, mainly sand and gravel, and 5.92 cubic yards of bowlders over 2 tons weight were excavated from the channel.

Mr. A. H. Dickens was the local inspector of the work

By act of August 11, 1888, Congress appropriated $10,000 for continuing the improvement. A project for the expenditure of this sum was accordingly prepared and was approved by the Chief of Engineers. This project contemplates extending the channel from the upper end of the work under the last contract towards Westerly as far as the funds will permit, and the removing of such small areas of ledge rock as may be uncovered by dredging, and affording such relief as the commerce may require at the shoalest places above the main work.

Advertisements for proposals for dredging under this project were published December 8, 1888. One proposal was received and was opened January 8, 1889. It was not made in accordance with the specifications, and the price bid was excessive. The proposal, therefore, was rejected and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of the proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town; also the removal of the ledge rock near Certain Draw Point and Pawcatuck Rock.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the work of widening and deepening the channel, according to the new project, as far toward Westerly as the funds will admit, and also to afford such relief as the commerce of the river may require at the shoalest places in advance of the main work, and to remove the points of ledge rock referred to above.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $260,818.27; Stonington, $1,375.50. The nearest light houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1888, amount available		$399 00
Amount appropriated by act of August 11, 1888		10,000 00
		10,399 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	$789 77	
July 1, 1889, outstanding liabilities	35 38	
		825 15
July 1, 1889, balance available		9,573 85
Amount (estimated) required for completion of existing project		16,637 00
Amount that can be profitably expended in fiscal year ending June 30, 1891		16,637 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock, noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889].

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging per cubic yard.*
			Cents.
†1	J. H. Fenner, Jersey City, N. J.		40

* Measured in scows. † Informal.

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock, noon, on Tuesday, the 23rd day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging per cubic yard.*
			Cents.
1	E. M. Payn, Albany, N. Y.	$10 00	38.9
2	Hartford Dredging Company, Hartford, Conn.	10 00	60

* Measured in place.

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxson & Co., Westerly, R. I.]

Receipts at Westerly by water.

Coal	tons,	18,894
Sand	"	892
Lumber	feet,	4,152,167

Bricks		1,195,700
Grain	bushels,	71,000
Pig-iron	tons,	925
Shipments.		
Stone	tons,	2,180
Number of passengers carried by steamers	(about)	50,000

PRELIMINARY EXAMINATON OF ENTRANCE TO POINT JUDITH POND, WEST OF POINT JUDITH, RHODE ISLAND. WITH A VIEW TO ESTABLISHING A HARBOR OF REFUGE.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of entrance to Point Judith Pond, west of Point Judith, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by Capt. T. L. Casey, Corps of Engineers, on the 11th of October last:

Point Judith Pond is located in the southeastern part of the town of Kingston, R. I; is about 3 miles in length, and varies from one-half mile to 1 mile in breadth. It is connected with the ocean by a narrow, tortuous channel having a depth of from 3 to 8 feet at mean low water.

The low water level in the pond is about 2.5 feet above that of the ocean. The mean range of the tide in the latter is about 3 feet, and in the former is said to vary from 6 to 9 inches.

A careful survey of this locality was made in 1873, under the direction of Gen. Warren, a report on which may be found in the Annnal Report of the Chief of Engineers for 1874, pages 117-120.

The examination just made by Captain Casey shows that since the date of Gen. Warren's report the branch forming the outlet to the pond has materially deepened and that the level of the pond has been somewhat reduced. It was found in 1873 that this level was 4.5 feet above mean low water, and the water almost entirely fresh. Captain Casey estimates that the low level of the pond can not be more than 2.5 feet above low tide in the ocean, and at high tide strong currents enter the pond, and further states that if a navigable channel 200 feet wide and 7 feet deep were excavated as indicated on the diagram marked A the depth of the pond would be reduced by that much.

On the accompanying sketch the curves of equal depth have been plotted from the map of General Warren's survey.

Captain Casey says "it would be perfectly feasible to excavate a channel into the entrance of the harbor to a depth of 7 feet at mean low tide." He estimates that this would produce a tidal current of about 8 miles per hour, and that the depth of the pond would thereby be reduced about 2.5 feet.

A harbor of refuge might also be established at the entrance to the pond with the same facility as at any other point on the sea-coast which afforded no material advantages therefor, but could not be maintained unless by constant dredging.

The cost of building breakwaters to inclose an area of one-fourth of a square mile, with an average depth of 20 feet, is roughly estimated at $800,000, and the original cost of excavating a channel into the pond to a depth of 7 feet at mean tide is roughly estimated at $40,000. Perhaps it could be maintained by an annual expenditure somewhat less than this amount.

General Warren, in his report on this locality, says:

> To secure an artificial enlargement of the outlet, extensive stone jetties would be required on each side to prevent the opening being filled with sand, and even these, unless of very great extent, would be of doubtful effect, for the beach is composed of shifting sand, exposed to the full force of the ocean waves.
>
> The village of Wakefield is situated at the head of this pond, and if vessels of moderate draught can be made to reach it the people would be much benefited; but the cost of making suitable works to effect this would be so great that nothing but the commerce of a great city like New York would justify the attempt. There, an artificial harbor costing millions could be afforded, and only under its shelter could the beach be kept permanently open. I therefore submit no estimate for improvement.

The present and prospective demands of commerce justify a small harbor of refuge in this vicinity. Such a harbor is recommended in my report of the preliminary examination of coast near life-saving station, East Point Judith, which is about 2 miles east of the entrance to Point Judith Pond.

In my opinion the entrance to Point Judith Pond, west of Point Judith, is not worthy of improvement, with a view to constructing a harbor of refuge. A copy of Captain Casey's report is inclosed with my report of preliminary examination of East Point Judith.*

Point Judith Pond is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingston by the Rhode Island State census of 1885, was 5,549.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

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* Copy submitted herewith.

REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., October 12, 1888.

SIR: The following is a report of the preliminary examination of Point Judith Pond and the coast-line thence to Point Judith, R. I., with a view to the establishment of harbors of refuge.

On the morning of October 11, the party set out from the upper end of the upper pond in a small steam-launch belonging to Mr. Jrh. P. Robinson and brother, of Wakefield. A sounding-rod had been provided graduated to feet. Soundings were taken at intervals of about a fifth of a mile. The course lay down the upper pond to the Narrows; thence in a nearly straight course to the interval between Gardiner's Island and a smaller island lying immediately to the eastward and thence in a gentle curve to High Point.

As indicated on the accompanying map, the soundings taken show that from the upper end of the pond to a point nearly opposite Buff Island, a distance of about 2 miles, a channel depth of about 10 feet can easily be obtained; but from the latter point to the entrance the depth became rapidly less, and in order to obtain sufficient depth of water for commercial purposes extensive dredging will be necessary.

At a point about one-half a mile below High Point the party left the launch because of the eel-grass, which impeded the propeller, and took to a flat bottom skiff. As we approached the entrance along the dotted line on the map, it could be seen that there was a perceptible current setting into the pond and into the narrow passage forming its outlet. This current became so strong that headway could be made with difficulty against it. The depth in the narrow, tortuous outlet varied from 3 to 8 feet. The tide was at its full and there was no appearance of a bar at the entrance. As the mean range of the tide on the coast is about 3 feet and as the known range of the tide in the pond is from 6 to 9 inches it follows that the low level of the pond can not be much more than 2.5 feet above mean low tide in the ocean, and that if a navigable channel 200 feet wide and 7 feet deep (at mid-tide) was excavated, as indicated on the diagram marked A, the depth in the pond would be reduced by that amount at low tide. By a rough calculation, assuming the area of the pond to be 1¾ square miles, such an outlet as that just indicated would accommodate the incoming and outflowing tide with a current of 3 miles per hour. If a row of guide-piling sheathed with planks be driven along the borders of the artificial channel and cut off at a height of 8 feet above the high-water level it would serve to retain the current for purposes of deepening the channel and would at the same time serve as a catch for the loose sand, which is sometimes extensively shifted by the wind.

If a harbor of refuge is to be built on the coast to the westward of Point Judith it would seem that the best location for it would be at the entrance of this pond, where it would serve at once as harbor of refuge and as a quiet port wherein vessels might discharge cargoes upon lighters which could then be towed up the pond to Wakefield.

There is no part of the coast between the entrance and Point Judith which could be advantageously chosen as a site for the harbor because of a long ledge which extends for nearly a mile in a south by easterly direction from a point nearly one-half mile from the shore near the entrance of the pond. This ledge would effectually bar the progress of any vessel drawing more than 13 feet of water and its attempt to reach such a harbor from the southwest, and would at all times be dangerous.

The position of the proposed harbor is indicated on the map.

Proceeding to the life-saving station at Point Judith, the captain of the crew was asked his opinion as to the position and nature of the proposed breakwater to the north of the point. The position of the breakwater, as traced by him, is shown on the map, and it was suggested that a small prolongation at right angles to the axis and from its extremity would be very useful, and such a form far superior to the arc of a circle.

If the breakwater be built in this position it is suggested that it be capped with large rough-finished stones, so that it could serve some of the purposes of a dock.

On reviewing the entire project, which although threefold in its nature is in reality only one, it should be said in conclusion, that it is quite possible, and as far as the Wakefield harbor of refuge and the Point Judith breakwater are concerned, almost a necessity.

Appended (marked B) there is a list of the vessels which have been wrecked on this coast from the Point Judith Pond Inlet to a point midway between the point and Narragansett Pier. It was very obligingly furnished by the captain of the life-saving crew.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

Maj. W. R. LIVERMORE,
Corps of Engineers.

B.—List of vessels wrecked near Point Judith, 1883-'88.

Names wrecked.	When wrecked.	Valuation of vessels.	Valuation of cargo.	Nature.
Schooner Warren Gates	Mar. 25, 1883	$4,000	$6,500	Steel wire.
Schooner Thomas R. Pillsbury	June 13, 1883	28,000	2,500	Coal.
Schooner Julia A. Tate	May 10, 1884	4,000	3,500	Log-wood and axles.
Schooner Idlewild	June 6, 1884	2,000	1,125	Grain.
Schooner Almon Bacon	Nov. 5, 1885	3,000	2,000	Iron.
Schooner Mott Haven	Dec. 25, 1885	6,000	1,900	Furniture and oil.
Schooner Willie DeWolf	Dec. 25, 1885	3,000	1,500	Lumber.
Schooner Allen Greene	Jan. 9, 1886	12,000	No cargo.	Ballast.
Steamer Miranda	June 20, 1886	110,000	31,500	General cargo.
Schooner Mary Natt	Dec. 1, 1886	1,200	2,700	Iron.
Schooner Harry A. Barry	Feb. 20, 1887	25,000	4,275	Coal.
Schooner Mary A. Drury	Dec. 31, 1887	10,000	2,000	Coal.
Brig John Welsh, Jr.	Mar. 3, 1888	1,500	1,200	Coal.
Schooner Maggie J. Smith	Nov. 10, 1887	35,000	5,000	Coal.
Schooner Henry H Olds	Apr. 12, 1888	45,000	5,000	Coal.
Schooner Anita	May 2, 1888	3,000	1,800	Lumber.
Schooner Earl P. Mason	Aug. 22, 1888	17,000	3,000	Coal.
Schooner Isaac H. Borden	Sept. 9, 1888	500	3,000	Oil.

Total number of wrecks, 18; total valuation of vessels, $310,200; total valuation of cargo, $78,500.

PRELIMINARY EXAMINATION OF WESTPORT HARBOR AND EAST AND WEST BRANCH OF WESTPORT RIVER, MASS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Westport Harbor and East and West Branch of Westport River, Massachusetts, provided for in the river and harbor act of August 11, 1888, and made by Maj. W. R. Livermore, Corps of Engineers, and Mr. Edward Parrish, assistant engineer, on the 13th November last.

Westport Harbor is an estuary on the coast of Massachusetts, lying between

Narragansett Bay, Rhode Island, and Buzzard's Bay, Massachusetts. The continuations northward of this estuary are known as the East and West Branches of Westport River; the former has a width of about three-fourths of a mile for some 4 miles from its mouth, and the latter is about one-half mile wide for 3 miles of its length. Both of these branches are included in the town of Westport, Bristol County, Massachusetts.

The village of Adamsville, in the town of Little Compton, R. I., lies at the head of navigation of the West Branch.

The entrance from the harbor of Westport to the West Branch of the river is somewhat obstructed by a shoal known as the "Lion's Tongue," but with this exception the branch has a navigable channel of about 10 feet at mean low water up to a point some three-fourths of a mile below Adamsville. This channel could be maintained and somewhat improved at an expense of a few hundred dollars, which might properly be undertaken by the General Government, if there were any wharves or other facilities for landing cargoes at the upper end, or any probable demand for such a channel.

A steamer drawing 6 feet of water runs regularly between Fall River and Adamsville during the summer and occasionally in winter, but can only reach the latter point for about one hour at extreme high tides, through a narrow and very tortuous channel.

The first cost of excavating a channel to Adamsville, for vessels drawing 10 feet, is roughly estimated at $6,000. The present demands of commerce do not appear to justify the expenditure of this sum. A good road about 4 miles long leads from Adamsville to Westport Harbor, one of the points now under consideration.

The head of navigation of the east branch of Westport River is at Westport Point. Vessels drawing 7 feet can reach this point at all stages of tide, and according to the best information I have been able to obtain after considerable inquiry there is no demand of commerce or desire of the citizens of the several villages or towns lying on or near this branch for any improvement of it above Westport Point.

It appears to me that the commercial requirements of the communities of Westport Harbor and on the branches of the river can best be obtained by the expenditure of about $2,000 in extending the jetty on Horse Neck Point or building other structures, and perhaps by dredging a little in Westport Harbor.

In my opinion Westport Harbor is worthy of further improvement by the General Government. The cost of a survey of the locality is estimated at $150.

A sketch showing the location of the proposed improvement, and one of the neighboring country, are herewith inclosed.

Westport Harbor and River are in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last fiscal year was $29,023.98. The nearest light-house is Seaconnet Light. The nearest fortification is the fort at Clark's Point, New Bedford, Mass. The population of Westport, Mass., by the United States census of 1880, was 2,894, and that of Little Comptom, by the Rhode Island State census of 1885, was 1,055.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, *U. S. Army.*

LETTER OF POSTMASTER OF ADAMSVILLE, RHODE ISLAND.

ADAMSVILLE, R. I., December 13, 1888.

DEAR SIR: I was very sorry not to have met you when you came to Adamsville, R. I., that I might have given you an aggregate of the amount of business done in this place and the consequent necessity of better water communication to and from this place. In the first place we are remote from any railroad communication, our nearest station being 10 miles distant. This compels us to look for less expensive ways of transporting goods, etc., to this place, and the best and cheapest way is by water. In this way we have brought to this place yearly:

Coal, (about)	$2,000
Lumber, (about)	5,000
General merchandise	20,000
Grain	40,000

Also quantities of produce to ship away, and the barrier against progress in our doubling our sales and increasing the growth and prosperity of this section is largely due to the bad channel communication between Westport Harbor and Adamsville. In the west branch of Westport River the channel wants widening, and in some places deepening, and several rocks located in the bottom of the channel want removing. In many places the channel wants straightening, and with an outlay of probably $6,000 or $7,000 this place could be reached with vessels drawing 7 or 8 feet of water, and with the dispatch necessary to success.

Mr. William Valentine, of Westport Point, Mass., has carefully looked into this matter and thinks this the only way that this place (Adamsville) can ever be successfully reached.

Hoping this may meet with your approval, and that it may be surveyed soon so that the report may be sent in at the coming meeting of Congress,

I remain yours, very respectfully,

ABRAHAM MANCHESTER, *P. M.*

Maj. W. R. LIVERMORE,
Corps of Engineers.

P. S.—I inclose a few of the many names of our people who are interested in this enterprise and desirous of having the survey, and hope for an appropriation in the near future.

Yours truly, ABRAHAM MANCHESTER.

PETITION OF THE CITIZENS OF ADAMSVILLE, RHODE ISLAND.

DEAR SIR: We, the undersigned, would respectfully represent and petition your honorable body, asking that a survey may be made of the west branch of Westport River from Westport Harbor to Adamsville, beginning at a point in the channel called the Lion's Tongue, which needs widening, thence to Adamsville Wharf. The channel in most places needs widening and deepening to accommodate the steam-boats and sailing-vessels which are in constant use on this river, transporting merchandise, grain and produce. We would also ask that this survey might be made so that a report of the same may be made to the committee at the next meeting of Congress.

[Signed by Capt. O. P. Head and eighty-one others.]

Maj. W. R LIVERMORE,
Corps of Engineers.

PRELIMINARY EXAMINATION OF FISHING-PLACE COVE, NEAR SEACONNET POINT, RHODE ISLAND, WITH VIEW TO CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Fishing-Place Cove, near Seaconnet Point, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me on the 30th of October last.

Fishing-Place Cove is about three-fourths of a mile north of Seaconnet Point, in the southwestern part of Little Compton Town, Newport County, R. I.

In 1827 this point, known as Church's Cove, was surveyed by Lieutenant-Colonel Anderson, of the Topographical Engineers and Lieutenant Prescott, First Artillery, who prepared a project for a breakwater here, extending north about 400 feet from the rock forming the southwestern limit of the cove.

On visiting the site I found the remains of an old breakwater which appeared to have been built for about 200 feet from shore, and all but the shore end in ruins. A wharf had been built immediately to the east of this, for a steamboat landing.

The inhabitants of the neighborhood told me that they had petitioned to have this breakwater rebuilt. Isaac W. Howland writes from Little Compton that he is the agent of the steamer *Queen City* and would like to have the breakwater extend out to a certain rock about 250 feet from shore. A copy of his letter is forwarded herewith.

This is the only landing place on the shores of Little Compton; it is important to the fishing interests, and if protected by a breakwater would form a convenient harbor of refuge for small vessels navigating the coast.

It is roughly estimated that for $5,000 the breakwater could be restored for at least a portion of its length, and a small area inside the cove could be dredged so as to somewhat increase the anchorage area for small vessels. In my opinion, Fishing-Place Cove is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at $200.

Seaconnet River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Seaconnet Light; the nearest fortification is Fort Adams, Newport, R. I. The population of Little Compton by the Rhode Island State census of 1885 was 1,055.

A tracing of Lieutenant-Colonel Anderson's map of 1827, showing the location of the proposed improvement, is herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER FROM MR. ISAAC W. HOWLAND.

LITTLE COMPTON, November 16, 1888.

SIR: In relation to the breakwater at Seaconnet Point, we as owners of steamer *Queen City* want one to extend out to a certain rock that is about 250 feet from shore. Our boat is over 100 feet long and it is impossible to lay here over night with a fresh breeze. As many as thirty vessels make harbor here at times. With such a breakwater the steamer could stay over night, and be a better harbor for others. Any other information required would be glad to give you.

Yours respectfully,

ISAAC W. HOWLAND,
Agent Queen City.

Major LIVERMORE.

PRELIMINARY EXAMINATION OF GREENWICH BAY, TO DEEPEN WATER ON THE BAR AT LONG POINT, RHODE ISLAND.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Greenwich Bay, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by Capt. Thomas L. Casey, Corps of Engineers, on the 19th October last.

Greenwich Bay is an arm of Narragansett Bay, and is located in Warwick and East Greenwich towns, Kent County, R. I. It has a length from northwest to southeast of about three and one-half miles and an average width of about one and one-half miles. The town of East Greenwich is located on the southwestern shore of the bay.

Captain Casey's report, herewith inclosed, explains the nature of the improvement desired as well as the demands of commerce. The cost of the improvement is roughly estimated at $2,000.

In my opinion Greenwhich Bay is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at $250.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $222,195.01. The nearest light-house is Warwick Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of East Greenwich by the Rhode Island census of 1885 was 2,659, and that of Warwick was 13,286.

A Coast Survey map of Greenwich Bay, showing the location of the proposed improvement, is herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

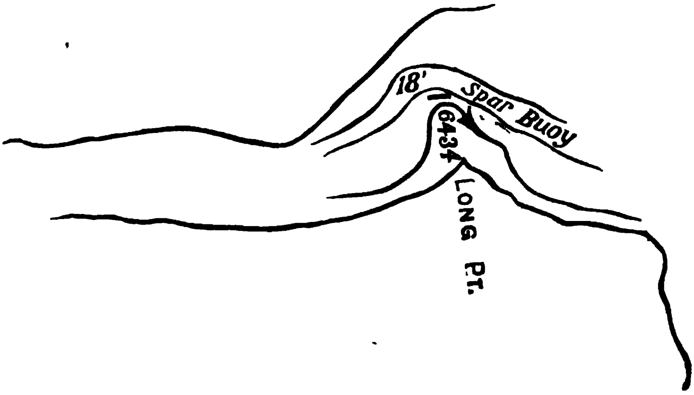
The CHIEF OF ENGINEERS, U. S. A.

REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., October 20, 1888.

MAJOR: I have the honor to submit the following report of a preliminary examination of the bar near Long Point, harbor of East Greenwich, R. I.

October 19 I proceeded to East Greenwich and was conveyed in a row-boat to the bar in question, which is a submarine continuation of Long Point. Between Long Point and the opposite shore there is a spar-buoy in the position marked on the accompanying diagram. The tide was at low stage at the time the soundings were taken. The latter indicate low-water depths of from 3 to 7 feet from Long Point to the spar-buoy, between which and the opposite shore there is ample depth for purposes of navigation. I understood that the depth of water was entirely satisfactory, but that it was desired to widen the channel, which is rather crooked, by taking off a portion of the bar extending out from Long Point. This could be easily accomplished with an expenditure of about $2,000, giving a low-water depth of 10 feet over a channel width twice as wide as that at present in use.



It was stated that about 5,000 tons of coal are landed here every year and the total commerce amounts to perhaps $25,000.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain Engineers.

Maj. W. R. LIVERMORE,
Corps of Engineers, U. S. A.

PRELIMINARY EXAMINATION OF NARRAGANSETT BAY AT THE MOUTH OF NARROW RIVER, RHODE ISLAND, WITH A VIEW OF CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Narragansett Bay at the mouth of Narrow River, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me on the 8th October last.

Narrow River empties into the western side of Narragansett Bay about 6 miles above Point Judith and about 1¼ miles northeast of Narragansett Pier. It is in South Kingstown, Washington County, R. I.

It connects the waters of Petaquamset River and a cove of the same name with Narragansett Bay.

The former is navigable for small vessels for a distance of about 5 miles to the northward of its junction with Narrow River about three-fourths of a mile from the mouth of the latter. The cove extends to the southward about 1¼ miles and is navigable for flat-boats.

These bodies of water form tidal reservoirs which tend to scour the bottom of Narrow River, the waters from which carry comparatively little sediment. Such shoaling as occurs at the mouth of the river is probably occasioned by the wash of sand from the beach to the southward.

The parties desiring the improvement ask for the construction of a breakwater extending from the beach below the mouth of Narrow River, first in a southeasterly direction for a distance of about 1,200 feet, thence northeasterly about 300 feet, for the purpose of stopping the movement of the sand along the beach into the mouth of the river. They also propose to build a line of railroad from this harbor to Narragansett Pier about 1¼ miles to the southward and wharves for landing within the harbor.

The present landing at Narragansett Pier is not available in bad weather, as it is unprotected from the sea, and there is no other landing in the vicinity. It is also controlled by private parties.

The shores in the vicinity are bold and rocky except to the south, where they are high and cultivated, the sand being protected from the wind by sod.

It is stated that the cost of fuel and building material would be reduced from one-fourth to one-third by the establishment of a harbor wherein vessels could load and unload in safety, and that about 8,000 to 9,000 inhabitants would be benefited by the improvement, both in cheapening the cost of living and facilitating the shipment of their products.

A rough estimate of the cost of a breakwater here is $80,000. I am of opinion that Narragansett Bay at the mouth of Narrow River is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at $300.

Narrow River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Whale Rock Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingstown, by the Rhode Island State census of 1885, was 5,549, and that of North Kingstown was 3,894.

Commercial statistics are hereunto appended, and a sketch showing location of the proposed improvement and one of the neighboring country are herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

COMMERCIAL STATISTICS.

[Furnished by Mr. George N. Kenyon.]

Material landed at Narragansett Pier from June 1, 1887, to October 15, 1888.

Coal	tons..	11,906
Brick	number..	481,000
Corn	bushels..	28,800
Cement	tons..	225
Lime	barrels..	1,829
Lumber	feet..	3,295,000
Shingles	number..	1,159,000
Laths	" ..	1,119,000
Railroad iron	tons..	200
Water pipe	" ..	220
Oyster shells	" ..	220

Besides twelve cargoes containing general merchandise, blue-stone, railroad-ties, etc.

SURVEY OF NARRAGANSETT BAY AT THE MOUTH OF NARROW RIVER, RHODE ISLAND, WITH A VIEW OF CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 6, 1889.

GENERAL: I have the honor to make the following report of survey at the mouth of Narrow River, Rhode Island, a report of the preliminary examination of which was made December 14, 1888.

Department letter of April 1, 1889, notified me that an allotment had been made to defray the expenses of surveys in this district, and as soon thereafter as possible they were commenced. Heavy seas and dense fogs delayed the completion of the survey at this place until the end of June.

Narrow River is about three-fourths of a mile long, and lies in the eastern part of South Kingstown, Washington County, R. I.,* about 6 miles above Point Judith, and acting as an outlet for the waters of Pettaquamscott River and cove, empties into Narragansett Bay at a point about 1¼ miles northeast of Narragansett Pier, a town of considerable importance as a summer watering place. A sandy beach extends from this town northward to the mouth of Narrow River, where the west shore of Narragansett Bay suddenly becomes bold and rocky. Granite of good quality has been quarried from a ledge on the north bank of the river. This ledge serves to protect the entrance to the river from northeast storms, while those from the south carry the sand northward and contract the mouth of the river.

It is thought by those who desire the improvement that a breakwater extending out from a point on the beach south of the entrance will stop the movement of this sand and will afford a sufficient area of smooth water to enable vessels to receive and discharge their cargoes.

Narrow River and its main branch, the Pettaquamscott River, are navigable for about 5¼ miles above the mouth of the former; the cove is navigable for flatboats.

The estimated cost of a breakwater, the position of which is shown on the accompanying map, marked "A," is $24,000. No further expenditure is recommended, as any improvement here is of doubtful permanence on account of the shifting sand. The requirements of this locality can never demand an extensive harbor, inasmuch as one more than a hundred times as large could be made a few miles to the northward, as shown on the accompanying map, marked "B," by constructing on the south, at the point marked "*a*," a breakwater at a cost of $150,000, and later, if found necessary, on the north, at the point marked "*b*," another, at a cost of $75,000. This would form one of the most perfect sea-ports in the Northern States, far superior in all respects to Providence, Newport, or Fort Pond at the eastern end of Long Island.

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* It is understood that a district called Narragansett has recently been formed embracing the eastern part of this town.

The following is the estimated cost of breakwater at Narrow River:

44,000 tons of rip-rap granite, at 50 cents	$22,000
Contingencies	2,000
Total	24,000

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

EXTRACTS FROM LATER REPORTS MADE BY MAJOR LIVERMORE, TO THE CHIEF OF ENGINEERS.

PRELIMINARY EXAMINATION OF COVE NEAR SOUTHEAST EXTREMITY OF COASTERS' HARBOR ISLAND AND WATER-WAY BETWEEN SAID ISLAND AND RHODE ISLAND, WITH A VIEW TO DEEPENING THE WATER-WAY AND REMOVING OBSTRUCTIONS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December, 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of cove near southeast extremity of Coasters' Harbor Island and water-way between said island and Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me frequently in August and September last.

This cove and water-way, situated in the northwestern part of the city of Newport, Newport County, R. I., at the southeastern extremity of Coasters' Harbor Island, are used by the United States Navy as a training station. The old 74-gun ship *New Hampshire* is permanently anchored at the southeast point of the island.

I am informed by Commander Higginson, United States Navy, in command of the training station, that the improvements desired are to have the cove deepened at a point near the causeway which forms its northern boundary, at least enough to afford a berth for the *Saratoga*, or a vessel of that class, and to dredge a channel leading to it from the harbor utilizing the dredged material for building up the island, also to have the water-way between Coasters' Island and Rhode Island deepened so that the flow of water through it will be sufficient to carry off all the garbage, etc., that is thrown from the training ship, and which if allowed to accumulate would in time not only cause sickness on the ship, but to the residents of the adjacent country. The water-way is now crossed by a causeway having only one opening and in consequence is rapidly filling up.

In my opinion the cove is worthy of improvement by the General Government, and perhaps something might be done to improve the water-way.

The cost of dredging the cove is roughly estimated at $5,000, and in the waterway from $5,000 to $15,000. The cost of a survey of the locality is estimated at $200. A sketch of the cove and water-way showing the location of the proposed improvement is herewith inclosed.

Coasters' Harbor Island is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Gull Rock Light. The nearest fortification is Fort Adams, Newport, R. I. The population of Newport by the State census of 1885 was 19,556.

Very respectfully, your obedient servant,

W. R. Livermore,
Major of Engineers.

The Chief of Engineers, U. S. A.

SURVEY OF COVE NEAR SOUTHEAST EXTREMITY OF COASTERS' HARBOR ISLAND AND WATER-WAY BETWEEN SAID ISLAND AND RHODE ISLAND, WITH A VIEW TO DEEPENING THE WATER-WAY AND REMOVING OBSTRUCTIONS.

Engineer Office, U. S. Army,
Newport, R. I., December 6, 1889.

General: In compliance with Department letter of April 1, 1889, I have the honor to submit the following report of survey of cove near southeast extremity of Coasters' Harbor Island and water-way between said island and Rhode Island. My report of the preliminary examination of this cove and water-way was submitted December 14, 1888, accompanied by a sketch showing the location of Coasters' Harbor and the water-way, with reference to Newport and the adjacent islands.

They are situated in the northwestern part of the city of Newport, Newport County, R. I. A causeway connecting Coasters' Harbor Island with Rhode Island, forms the northern boundary of the cove and separates it from the water-way above. This causeway having but one small opening has checked the flow of water around the island and caused deposits, which have filled up the water-way so that the bottom is exposed at low tide, and the eel grass and decomposed vegetable matter with which it is covered impregnate the atmosphere with disagreeable and unhealthy odors.

The United States naval training station is located here, and until recently the training ship *New Hampshire* was anchored in the cove at the southeastern extremity of Coasters' Harbor Island. The refuse from this vessel has remained in the cove, and on account of sickness and death the *New Hampshire* has been removed to the deep water south of the island and the apprentices are quartered on the island.

The improvement desired is to deepen the anchorage area in the cove and to increase the flow of water around the island.

PROJECT.

It is proposed to make two additional openings in the causeway, each 60 feet wide, spanned by wooden bridges 30 leet long resting on stone piers. It is understood that in the future training vessels manned with their full crews will not be permanently anchored in the cove.

The cost of this improvement is estimated as follows :

Making openings and constructing bridges	$3,000
Dredging	2,000
	$5,000
Contingencies 10 per cent	500
Total	5,500

The area to be dredged and the approximate position of the proposed openings in the causeway are indicated on the accompanying map of the recent survey by parallel lines.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

PRELIMINARY EXAMINATION OF COAST NEAR LIFE-SAVING STATION, EAST POINT JUDITH, RHODE ISLAND, WITH A VIEW TO CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of coast near life-saving station, East Point Judith, Rhode Island, provided for in river and harbor act of August 11, 1888, and made by Capt. Thos. L. Casey, Corps of Engineers, on the 11th of October last.

Point Judith is the southeastern extremity of South Kingstown Township, Washington County, R. I., and marks the southwestern entrance to Narragansett Bay.

Captain Casey recommends the establishment of a harbor of refuge in this locality. His report is accompanied by two sketches and a list of vessels which have been wrecked there between 1883 and 1888. I have been told that the loss of the larger of these vessels was caused by fogs and not by storms. The amount of commerce passing Point Judith is too well known to require detailed description. The point is an exceedingly dangerous one to navigation. While vessels of large size can ride in the trough of the sea to a safe shelter in Narragansett Bay, a harbor of refuge for smaller vessels is much needed here.

Such a harbor can be established by the construction of breakwaters, at a cost, roughly estimated, of $300,000, which would also afford relief to the commerce of the neighboring villages, and furnish a landing for the boats of the Point Judith life saving service, which now often can not be effected nearer than Newport or Block Island. I am therefore of the opinion that East Point Judith is worthy of improvement by the General Government, and estimate the cost of a survey of the locality at $300.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingstown by the Rhode Island State census of 1885 was 5,549.

Captain Casey's report is herewith inclosed.*

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. ARMY.

SURVEY OF COAST NEAR LIFE-SAVING STATION, EAST POINT JUDITH, RHODE ISLAND, WITH A VIEW TO CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 6, 1889.

GENERAL: In compliance with instructions contained in Department letter of April 1, 1889, I have the honor to make the following report of a survey of the coast near life-saving station, East Point Judith, R. I. This was completed in the month of July. A report of the preliminary examination of the coast was submitted December 14, 1888.

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* Captain Casey's report will be found on previous pages.

Point Judith is the southeastern extremity of South Kingstown, Washington County, R. I., and marks the southwestern entrance to Narragansett Bay. Its shores are covered with bowlders, and the remains of a number of wrecks are scattered along the beach on both sides of the point.

The ebb tides from Narragansett Bay, Long Island Sound, and Buzzards Bay meet southeast of here, and when a heavy wind is blowing from that quarter the smaller class of vessels do not attempt to pass the point; those east of it run into either Newport or Dutch Island Harbors, a distance of 12 or 15 miles, while those west of it run for Stonington, Conn., distant 21 miles. The amount of commerce passing this point is considerable, but the larger vessels engaged in the coasting trade pass to the southward of Block Island, only about 10 miles distant, where in heavy storms they lie under the lee of its shores.

In my report of the preliminary examination of the coast near life-saving station, East Point Judith, Rhode Island, I stated that a harbor could be made by building breakwaters at a cost, roughly estimated, at $300,000. Subsequent examination, however, shows that such a harbor could not answer the requirements. A small area could be protected at a considerable cost, but the anchorage would not be good.

Although an examination of the coast immediately west of the point was not required by the act of Congress of August 11, 1888, the survey was extended as far to the westward as the funds would allow. The results of this survey and examination indicate that a harbor could be built here for about $1,250,000, that would be large enough for small vessels, but the bottom is hard and sandy and the currents strong.

The position of the breakwater is shown on the sketch.

The following is the estimated cost of breakwater at Point Judith.

1,100,000 tons of rip-rap granite, at $1	$1,100,000
Contingencies	150,000
Total	$1,250,000

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Eng 1010.37

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1891.

PROVIDENCE, R. I.
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1891.

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

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E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1891.

HARVARD COLLEGE
MAY 29 1917
LIBRARY

The commissioners.

REPORT.

To the Honorable the General Assembly
of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submits its Fifteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed William C. Clarke, of South Kingstown, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

Harbor lines in the southern portion of Point Judith Pond were designed and reported to the Governor and Senate for approval on the 28th day of May, 1890, and were approved on May 29, 1890 and attested by the signature of the Governor and the Secretary of State.

A proposed harbor line from near Saunderstown to near Bonnet Point and another along the shore opposite the District of Narragansett have been under consideration but no definite action in regard to them has been reached.

ENCROACHMENT AND DUMPING.

The usual care has been required during the year, occupying considerable time, in the routine work of preventing obstructions and encroachments in the public waters. The piling, and other portions of the structure of the old Riverside wharf, continues to cause complaint by navigators and some action should, in our opinion, be taken to secure its removal. The structure was extended farther from the shore than was authorized by the General Assembly, but the work was done before the establishment of this board and no responsible parties known to the board as liable for its present condition have been found. Possibly it would be well to give the board authority to expend, at its discretion, limited sums in the removal of obstructions for the existence of which there are no known persons responsible. Various minor obstructions have been removed at the request of the board.

The general dumping ground South of Prudence Island remains, as heretofore designated by the board. Permits have from time to time been given to dump limited amounts of dredged material under restrictions at various other points.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters as follows:

No. 116. February 19, to Thomas J. Hill to replace old piling and repair wharf, on the west side of Providence river, at the foot of Crary street in Providence.

No. 117. March 12, to Henry H. Carr to build a retaining wall and fill behind it on his land on the easterly side of Pawtuxet cove in Cranston.

No. 118. A dumping permit.

No. 119. A dumping permit.

No. 120. A dumping permit.

No. 121. May 14, to William B. Pearce to drive piles and repair wharf west of Dorrance street dock in Providence.

No. 122. April 23, to the City of Providence to extend outfall pipe sewers at Field's Point in Providence.

No. 123. June 11, to Charles C. Sherman and others to fill out to the harbor line abutting their estate in the southwesterly portion of Point Judith pond in South Kingstown.

No. 124. June 25, to Edgewood Boat Club to build a bridge wharf at the foot of Shaw avenue in Cranston.

No. 125. June 16, to Nathan B. Waldron to rebuild wharf near the foot of Brook street, on India street in Providence.

No. 126. June 25, to the city of Providence to drive piles and repair fender at the draw of Red Bridge in the Seekonk river in Providence.

No. 127. A dumping permit.

No. 128. July 9, to E. T. Pettigrew to build a bridge wharf at the foot of Wickenden street on the west side of Seekonk river in Providence.

No. 129. July 16, to Walter Richmond to build a bridge wharf and moor a float on the west side of Seekonk river northerly from the University Boat House, in Providence.

No. 130. July 16, to Charles Pay & Co. to build a bridge wharf near the foot of Sovereign street on South Water Street in Providence.

No. 131. August 13, to Henry Woge to drive piles for the support of a building north of Cedar Grove wharf in East Providence.

No. 132. July 30, to the City of Providence to build a retaining wall at the outlet of the Elmwood storm sewer, and fill behind it, northwesterly from Field's Point in Providence.

No. 133. July 30, to the Continental Steamboat Company to moor a scow northerly from Riverside wharf in East Providence.

No. 134. August 6, to G. Pettis and others to extend Cedar Grove wharf in East Providence.

No. 135. August 27, to Moulton O'Mahoney and Trumbull to drive piles northerly from Field's Point in Providence.

No. 136. September 24, to Doe and Little to rebuild wharf near Pike street on South Water street in Providence.

No. 137. An assent.

No. 138. A dumping permit.

No. 139. An assent.

Assent has been given as follows:

1. September 24, to John Carpenter to extend his wharf in Coweset bay in Warwick.

2. December 31, to Joseph Dews to extend wharf in East Greenwich.

WORK UNDER U. S. ENGINEER.

By the courtesy of Major William R. Livermore, Corps of Engineers, we have been furnished with a copy of his report to the Chief Engineers, U. S. A. for 1890, upon the work of which he is now in charge, from which we have made extracts in relation to the work in Rhode Island waters, which will be found in the appendix.

Preliminary examinations have been made with a view to the removal of the spit at the south end of Goat Island in Newport harbor. Also of Watch Hill Cove with a view to dredging a channel in the southeastern part of the cove. Also of Narragansett Bay Channel between Starve Goat Island and the main land, with a view of deepening the same.

Congress made an appropriation of seventy-five thousand dollars during the year to begin the construction of a breakwater westerly from Point Judith to form an important harbor of refuge for ocean vessels.

Respectfully submitted,

J. HERBERT SHEDD,
H. C. BRADFORD,
WM. C. CLARKE,
} Harbor Commissioners.

APPENDIX.

EXTRACT FROM REPORT OF MAJOR WILLIAM R. LIVERMORE TO CHIEF OF ENGINEERS, U. S. A., FOR 1890.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay, north of the harbor of Bristol. The obstructions to navigation were a rocky reef below Little Island, and a submerged bowlder, known as Bushworth Rock, near mid-channel, opposite the lower wharf of the town of Warren. By act approved August 5, 1886, Congress appropriated $5,000 for the improvement of the river, and with this sum it was proposed that the bowlder and reef referred to be removed as far as possible.

PLANS OF IMPROVEMENT.

The work of improvement was one that could not be well carried on by contract, and the approved project was first to remove Bushworth Rock, and afterwards to remove the bowlders which lay submerged on the western side of the narrowest portion of the channel at Little Island, and also the projecting portions of the ledge beneath the bowlders, widening the channel as much as the funds available permitted; it also included the hiring in open market of a vessel with working crew, submarine diver, firing battery, and steam-hoisting apparatus, and purchase of the explosives also in open market.

A plat of the river, showing the proposed improvement near Little Island, was published in the Annual Report of the Chief of Engineers for 1885, page 630.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The amount expended to June 30, 1889, including liabilities outstanding at that date, was $4,849.72. The result was the removal of Bushworth Rock to the depth of the surrounding water, and the removal of the bowlders and points of ledge rock over an area of about 1.8 acres in the vicinity of Little Island, extending 550 feet along the narrowest part of the channel. This work finished the improvement as far as projected.

OPERATIONS DURING THE LAST FISCAL YEAR.

No work was done during the last fiscal year.

Warren River is in the Bristol-Warren collection district, which is a port of entry. The amount of revenue collected in the last fiscal year is unknown. The nearest light-house is the light-house on Conimicut Point, Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

MONEY STATEMENT.

July 1, 1889, amount available		$119 78
July 1, 1880, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$93 99	
July 1, 1890, outstanding liabilities	16 86	
		$110 85
July 1, 1890, balance available		$8 93

COMMERCIAL STATISTICS.

[Furnished by Mr. John Waterman, Warren, R. I.]

Articles.	1888.	1889.	Articles.	1888.	1889.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Coal	16,090	14,089	Oysters	....	1,330
Lumber	2,146	1,625	Lime and Cement	180	150
Grain	2,100	2,610	Cotton	1,044	490
Feed	250	290			

Arrivals and Departures.

Year.	Schooners.	Steamers.	Barges.	Tow-boats.	Average Draught.
1888	81	4	....	....	13
1889	64	4	5	10	13

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 28,000, and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draught can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth, and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The total amount expended up to the close of the fiscal year ending June 30, 1889, including liabilities outstanding at that date, was $184,565.88. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge, a distance of about 12,740 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge, to Bass Rock, or to within about 1¼ miles of the head of navigation.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. The dredge *Newport*, hired of Brainard Brothers, of New York, commenced dredging August

29, 1889, and continued until November 9, 1889, when it was transferred to other work. The dredge *Yankee Notion*, hired of D. M. & C. W. Anthony, of Fall River, Mass., was engaged on the work from September 5 to October 1 in dredging one cut through the shoalest places that the scows of the larger dredge might work to better advantage. The dredge *C. H. Latham*, hired of the Hartford Dredging Company, was also engaged on this work from December 26 until January 23, when it was withdrawn on account of the liability of the river to freeze over. During the fiscal year 54,923 cubic yards of sand and 128 cubic yards of bowlders and ledge rock, besides numerous stumps, logs, and fallen trees, were excavated from the projected channel.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year, including liabilities outstanding to June 30, 1890, was $32,500.13 and the result was the dredging of the channel to a width of 60 feet from Bass Rock to a point about 200 feet above Dunnell's Wharf, which, in the opinion of those interested in the navigation of the river, it has been especially desirable to reach; and the purchase of dredging plant to the value of $10,805.61.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Co.'s Wharf, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

It is proposed to extend the channel toward Pawtucket by dredging and to commence work on the ledge. For this reason an appropriation of $100,000 is asked, instead of $50,000 as heretofore.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $269,858.00. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1889, amount available		$32,500 13
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$31,844 08	
July 1, 1890, outstanding liabilities	656 05	
		$32,500 13
Amount appropriated by act of September 19, 1890		$30,000 00
Amount (estimated) required for completion of existing project		$387,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		100,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Business Men's Association, Pawtucket, R. I.]

Receipts.

Articles.	1890.	Articles.	1890.
	Tons.		*Tons.*
Coal	121.594	N. R. stone	116
Lumber	2,777	Spool wood	450
Pickets	81	Iron	505
Laths	101	Fertilizer material	100
Shingles	39	Acid phosphate	175
Bricks	3,838	Potash	150
Lime	591	Gravel	262
Cement	495	Cotton	51
Fire-clay	5		

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel; first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field's Points of the following dimensions in cross-sections, viz.:

300 feet wide	25	feet deep.
600 feet wide	20	"
725 feet wide	18	"
940 feet wide	12	"
1,060 feet wide	6	"

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1889, including liabilities outstanding at that date was $246,883.36. At that date the 25-foot channel, 300 feet wide, had been completed. Bulkhead Rock had been removed. The excavation of the 20-foot anchorage area has been completed in Fox Point Reach, and of the same areas in the Sassafras Point and the Field's Point Reaches about one-fourth and one-half, respectively, has been done.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. August 13 the dredge *Newport*, hired of Brainard Bros., of New York, began work on the 18-foot area, Fox Point Reach, east side. Work was carried on with this dredge until August 28, 1889, when it was transferred to Pawtucket River. A dredge, hired of Henry Du Bois's Sons, of New York, continued the work until November 9, 1889, when it was transferred to New Bedford. The United States dredge *Texas* was engaged on this work from December 3 to 20, inclusive, and the dredge *C. H. Latham*, hired of the Hartford Dredging Company, was also at work here from January 24 to February 8, 1890, when it was transferred to other work. Ninety-six thousand and thirty-four cubic yards of mud were excavated, finishing the 20-foot area on the east side of the main channel Sassafras Point Reach, and the 18-foot area on the east side of Fox Point, and about three-fourths of the 18-foot area on the same side of Sassafras Point Reach.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1890, was $36,717.27, and the result was the completion of the 20-foot anchorage area on the east side of the Sassafras Point Reach, and the 18-foot area on the east side of the Fox Point Reach, and about three-fourths of the 18-foot area on the same side of the Sassafras Point Reach, and the purchase of plant to the value of $18,326.53.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field's Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

It is proposed to continue the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $269,858.00. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R.I.

MONEY STATEMENT.

July 1, 1889, amount available		$36,717 27
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$35,829 71	
July 1, 1890, outstanding liabilities	887 56	
		36,717 27
Amount appropriated by act of September 19, 1890		50,000 00
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		100,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Foreign Imports.

Articles.	1889.	Articles.	1889.
	Tons.		*Tons.*
Lumber	3,632	Ice	509
Shingles	657	Wool	3,815
Laths	1,407	Starch	149
Wood	1,166	Lime	121
Logwood	3,821	Potatoes	106
Pickets	54	Liquors	14
Piling	812	Tobacco	½
Brimstone	590		

By Water and Rail.

Articles.	1889.	Articles.	1889.
	Tons.		*Tons.*
Cotton	55,105	Flour	28,668
Wool	12,388	Grain	44,478
Coal	1,064,314	Dry goods	5,266
Iron and steel	65,876	Print cloths	2,616
Oil	24,008	Chemicals	8,348
Waste	5,811	Liquors	9,553
Beef	12,486		

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side a width of 300 feet and a depth of 20 feet, and the one on the south side a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, Vol. 1, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The amount expended, including outstanding liabilities, to June 30, 1889, was $28,064.37. The result was the excavation to a depth of 25 feet at mean low water of an area of about 9½ acres, extending along the western side of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of November 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. August 8, 1889, a dredge, hired by Henry Du Bois's Sons, commenced work on the shoal. The cuts were made parallel to the general direction of the harbor line on the north side of the shoal, and an area of about 4¼ acres was excavated to the required depth of 25 feet. On November 9, 1889, this dredge was transferred to other work. From January 6 to February 8, 1890, the United States dredge *Rhode Island* was at work on this shoal. The amount of material excavated was 147,520 cubic yards of mud and oyster shells.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1890, was $26,185.68, and the result was the enlargement of the anchorage area by about 4¼ acres, and the purchase of plant to the value of $7,177.04.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remainder of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

It is proposed to continue the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858.00. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

Pawcatuck River is in the collection district of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $269,858.00; Stonington, $1,590. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1889, amount available		$9,573 85
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$9,091 81	
July 1, 1890, outstanding liabilities	482 04	
		$9,573 85
Amount appropriated by act of September 19, 1890		$16,600 00
Amount (estimated) required for completion of existing project		$37 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		37 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxson & Co., Westerly, R. I.]

Receipts at Westerly by water.

Articles.		1888.	1889.
Coal	tons..	18,894	17,014
Sand	do...	892	1,275
Lumber	feet..	4,152,167	4,042,897
Bricks		1,195.700	351,000
Grain	bushels..	71,000	72,675
Pig-iron	tons..	925	1,094

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885. Vol. 1, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The amount expended up to the close of the fiscal year ending June 30, 1889, including outstanding liabilities at that date, was $109,489.21, with the following results:

Of the area to be dredged to 13 feet within the harbor, about nine-tenths had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The berth for vessels at the quartermaster's wharf at fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draught, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds have been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. On August 2, 1889, a dredge hired of Henry Du Bois's Sons, of New York, commenced work in the 13-foot anchorage area, but was soon afterward removed to Providence.

On August 27 a dredge hired of D. M. & C. W. Anthony, of Fall River, Mass., arrived in Newport, but on September 3 was transferred to Pawtucket to temporarily assist in the work there. On the 4th of October this dredge returned to Newport, and remained at work in the harbor until November 27. On November 13 and 14 two dredges, while en route to New Bedford from Providence, were detained in Newport harbor by bad weather, and the time was utilized in dredging. On the 12th of November a dredge hired from the Hartford Dredging Company commenced work in the harbor and continued until December 21, when it was taken off for other work until February 10, when it returned and worked until March 7. The United States dredge *Rhode Island* was also engaged on this work from November 2 to 16 and February 10 until March 8. Thirty-nine thousand six hundred and one cubic yards of material were excavated from the 13-foot anchorage area and from the western edge of the 15 foot channel north of the dolphin, and a small amount from near the north end of Goat Island.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year including liabilities outstanding June 30, 1890, was $10,712.82, and the result was the completion of the 13-foot anchorage area and the dredging of one cut along the western edge of the 15-foot channel north of the dolphin, and the purchase of plant to the value of $355.40.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the remainder of the narrow strip along the western edge of the 15 foot channel north of the dolphin and the excavation of the 10-foot anchorage area within the harbor, also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

It is proposed to complete the 15-foot channel as projected and extend the anchorage area as far as possible to the east and south.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $3,380.14. The nearest lighthouses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R.I.

MONEY STATEMENT.

July 1, 1889, amount available		$10,712 82
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$10,701 14	
July 1, 1890, outstanding liabilities	11 68	
		$10,712 82
Amount appropriated by act of September 19, 1890		$12,500 00
Amount (estimated) required for completion of existing project		$27,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		27,500 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

Receipts.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Lumber	19,749	18,855	Drain Pipe	....	5,000
Shingles	704	950	Sand and gravel	....	10,000
Laths	1,294	1,062	Flagstone	....	1,000
Coal	50,000	50,000	Granite	....	20,000
Lime	2,550	2,250	Iron	....	2,000
Cement	1,950	1,650	Ashes	....	41
Brick	18,000	18,800	Fish	....	2,000
Hay	1,500	5,000	Potatoes	....	1,800
Grain	1,200	1,800	Plaster	....	375
Cordwood	....	1,250	Hair	....	200
Marble	....	1,500			

Shipping.

Years.	Arrivals of vessels from foreign ports.		Vessels owned in Newport.	
	Number.	Value of cargoes.	Number.	Gross Tonnage.
1889	29	$16,271.92	143	7,694 54
1890	19	17,398.59	148	7,972 93

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats which upon the approach of storms were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening of 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and restoring the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of a shoal along the western side of the breakwater. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The total expenditures up to June 30, 1889, including liabilities outstanding at that date, was $340,931.39.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor, and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been carried to an extent sufficient to keep out the sea which was formerly driven through it into the outer harbor in easterly storms. The timber-jetty filled with stone forming the shore end of the western wall of the enlarged inner harbor and about 160 feet of its north wall east of the opening into the harbor had been finished, and about 90 feet of the wall west of the opening built to the level of mean high water.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. Work was resumed on the north wall of the enlarged inner harbor August 3, 1889, and 1,941 tons of riprap granite were placed in it and 420 tons on the breakwater during the last fiscal year. Of the stone delivered 1,265 tons were taken from Mason's Island Quarry, which is operated by the Government. November 18, 1889, the United States dredge *Rhode Island* commenced dredging in the enlarged inner harbor on the bar that had been formed on the western side of the breakwater.

The dredging extended from the end of the steam-boat wharf to within about 100 feet of the north wall. Three thousand and twenty-five yards of sand were dredged, making a depth of 9 feet at mean low water. The dredging was discontinued on December 28, 1889, and the dredge transferred to other work. Mr. F. I. Angell was the local superintendent of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1890, was $13,194.20, and the result was the extension of the north wall of the enlarged inner harbor 50 feet to the westward, and the use of 420 tons of stone in the proposed repairs to the breakwater and deepening the water to 9 feet on that part of the bar within the enlarged inner harbor that lies between the steamboat wharf and a line 100 feet from the north wall; also the purchase of plant to the value of $4,201.48.

THE WHARF AT BLOCK ISLAND.

In the annual reports of the officer in charge for some years past, attention has been called to the dilapidated and dangerous condition of the wharf. It is on the land side of the inner harbor and was built by the United States for purposes of construction of that work. Since completion of the inner harbor the only use of the wharf by the Government has been for the purpose of landing mails and supplies for the lighthouses, etc. This use it is thought does not warrant an estimate for its repair or reconstruction, which would cost perhaps $2,500.

In his annual report for the year 1886, Colonel Elliot, for reasons which were fully set forth, recommended that this wharf be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

Provided, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

During the past year the wharf has been temporarily repaired by the citizens of Block Island at their own expense. The location of the wharf may be seen in the plat published at page 613 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, and the enlargement of the inner harbor.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

If an appropriation is made it is proposed to apply it to the continuation of the work according to the existing project.

was $269,858.00. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R.I.

MONEY STATEMENT.

July 1, 1889, amount available		$36,717 27
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$35,829 71	
July 1, 1890, outstanding liabilities	887 56	
		36,717 27
Amount appropriated by act of September 19, 1890		50,000 00
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		100,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Foreign Imports.

Articles.	1889.	Articles.	1889.
	Tons.		*Tons.*
Lumber	3,632	Ice	509
Shingles	657	Wool	3,815
Laths	1,407	Starch	149
Wood	1,166	Lime	121
Logwood	3,821	Potatoes	108
Pickets	54	Liquors	14
Piling	812	Tobacco	½
Brimstone	590		

By Water and Rail.

Articles.	1889.	Articles.	1889.
	Tons.		*Tons.*
Cotton	55,105	Flour	28,668
Wool	12,388	Grain	44,478
Coal	1,054,814	Dry goods	5,266
Iron and steel	65,876	Print cloths	2,616
Oil	24,008	Chemicals	3,348
Waste	5,811	Liquors	9,558
Beef	12,486		

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side a width of 300 feet and a depth of 20 feet, and the one on the south side a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, Vol. 1, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1889.

The amount expended, including outstanding liabilities, to June 30, 1889, was $28,064.37. The result was the excavation to a depth of 25 feet at mean low water of an area of about 9½ acres, extending along the western side of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of November 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. August 8, 1889, a dredge, hired by Henry Du Bois's Sons, commenced work on the shoal. The cuts were made parallel to the general direction of the harbor line on the north side of the shoal, and an area of about 4½ acres was excavated to the required depth of 25 feet. On November 9, 1889, this dredge was transferred to other work. From January 6 to February 8, 1890, the United States dredge *Rhode Island* was at work on this shoal. The amount of material excavated was 147,520 cubic yards of mud and oyster shells.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1890.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1890, was $26,185.63, and the result was the enlargement of the anchorage area by about 4½ acres, and the purchase of plant to the value of $7,177.04.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remainder of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

It is proposed to continue the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858.00. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

Pawcatuck River is in the collection district of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $269,858.00; Stonington, $1,590. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

MONEY STATEMENT.

July 1, 1889, amount available		$9,573 85
July 1, 1890, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889	$9,091 81	
July 1, 1890, outstanding liabilities	482 04	
		$9,573 85
Amount appropriated by act of September 19, 1890		$16,600 00
Amount (estimated) required for completion of existing project		$37 00
Amount that can be profitably expended in fiscal year ending June 30, 1892		37 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxson & Co., Westerly, R. I.]

Receipts at Westerly by water.

Articles.	1888.	1889.
Coal .... tons..	18,894	17,014
Sand .... do...	892	1,275
Lumber .... feet..	4,152,167	4,042,897
Bricks	1,195,700	351,000
Grain .... bushels..	71,000	72,675
Pig-iron .... tons..	925	1,094

Shipments.

Stone	tons..	2,180	4,664
Lumber	feet..	....	82,000

Number of passengers carried by steamers (about):

1888	50,000
1889	81,400

PRELIMINARY EXAMINATION OF COVE NEAR SOUTHEAST EXTREMITY OF COASTER'S HARBOR ISLAND AND WATER-WAY BETWEEN SAID ISLAND AND RHODE ISLAND, WITH A VIEW TO DEEPENING THE WATER-WAY AND REMOVING OBSTRUCTIONS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of cove near southeast extremity of Coaster's Harbor Island and water-way between said island and Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me frequently in August and September last.

This cove and water-way, situated in the northwestern part of the city of Newport, Newport County, R. I., at the southeastern extremity of Coaster's Harbor Island, are used by the United States Navy as a training station. The old 74 gun ship *New Hampshire* is permanently anchored at the southeast point of the island.

I am informed by Commander Higginson, United States Navy, in command of the training station, that the improvements desired are to have the cove deepened at a point near the causeway which forms its northern boundary, at least enough to afford a berth for the *Saratoga*, or a vessel of that class, and to dredge a channel leading to it from the harbor. utilizing the dredged material for building up the island, also to have the water-way between Coaster's Island and Rhode Island deepened so that the flow of water through it will be sufficient to carry off all the garbage, etc., that is thrown from the training-ship, and which if allowed to accumulate would in time not only cause sickness on the ship, but to residents of the adjacent country. The water-way is now crossed by a causeway having only one opening and in consequence is rapidly filling up.

In my opinion the cove is worthy of improvement by the General Government, and perhaps something might be done to improve the water-way.

The cost of dredging the cove is roughly estimated at $5,000, and in the water-way from $5,000 to $15,000. The cost of a survey of the locality is estimated at $200. A sketch* of the cove and water-way showing the location of the proposed improvement is herewith inclosed.

Coaster's Harbor Island is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest lighthouse is Gull Rock Light. The nearest fortification is Fort Adams, Newport, R. I. The population of Newport by the State census of 1885, was 19,556.

Very respectfully, your obedient servant,

W. R. Livermore,
Major of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

SURVEY OF COVE NEAR SOUTHEAST EXTREMITY OF COASTER'S HARBOR ISLAND AND WATER-WAY BETWEEN SAID ISLAND AND RHODE ISLAND, WITH A VIEW TO DEEPENING THE WATER-WAY AND REMOVING OBSTRUCTIONS.

Engineer Office, U. S. Army,
Newport, R. I., December 6, 1889.

General: In compliance with Department letter of April 1, 1889, I have the honor to submit the following report of survey of cove near southeast extremity of Coaster's Harbor Island and water-way between said island and Rhode Island. My report of the preliminary examination of this cove and water-way was submitted December 14, 1888, accompanied by a sketch showing the location of Coaster's Harbor and the water-way with reference to Newport and the adjacent islands.

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* Not printed.

They are situated in the northwestern part of the city of Newport, Newport County, R. I. A causeway connecting Coaster's Harbor Island with Rhode Island, forms the northern boundary of the cove and separates it from the water-way above. This causeway having but one small opening has checked the flow of water around the island and caused deposits, which have filled up the water-way so that the bottom is exposed at low tide, and the eel-grass and decomposed vegetable matter, with which it is covered impregnate the atmosphere with disagreeable and unhealthy odors.

The United States naval training station is located here, and until recently the training-ship *New Hampshire* was anchored in the cove at the southeastern extremity of Coaster's Harbor Island. The refuse from this vessel has remained in the cove, and on account of sickness and death the *New Hampshire* has been removed to the deep water south of the island, and the apprentices are quartered on the island.

The improvement desired is to deepen the anchorage area in the cove and to increase the flow of water around the island.

PROJECT.

It is proposed to make two additional openings in the causeway, each 60 feet wide, spanned by wooden bridges 30 feet long resting on stone piers. It is understood that in the future training vessels manned with their full crews will not be permanently anchored in the cove.

The cost of this improvement is estimated as follows:

Making openings and constructing bridges	$3,000
Dredging	2,000
	$5,000
Contingencies 10 per cent	500
Total	$5,500

The area to be dredged and the approximate position of the proposed openings in the causeway are indicated on the accompanying map* of the recent survey by parallel lines.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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* Omitted; printed in House Ex. Doc. No. 63, Fifty-first Congress, first session.

PRELIMINARY EXAMINATION OF COAST NEAR LIFE-SAVING STATION, EAST POINT JUDITH, RHODE ISLAND, WITH A VIEW TO CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of coast near life-saving station, East Point Judith, Rhode Island, provided for in river and harbor act of August 11, 1888, and made by Captain Thomas L. Casey, Corps of Engineers, on the 11th of October last.

Point Judith is the southeastern extremity of South Kingstown township, Washington County, R. I., and marks the southwestern entrance to Narragansett Bay.

Captain Casey recommends the establishment of a harbor of refuge in this locality. His report is accompanied by two sketches and a list of vessels which have been wrecked there between 1883 and 1888. I have been told that the loss of the largest of these vessels was caused by fogs and not by storms. The amount of commerce passing Point Judith is too well known to require detailed description. The point is an exceedingly dangerous one to navigation. While vessels of large size can ride in the trough of the sea to a safe shelter in Narragansett Bay, a harbor of refuge for smaller vessels is much needed here.

Such a harbor can be established by the construction of breakwaters at a cost, roughly estimated of $300,000, which would also afford relief to the commerce of the neighboring villages, and furnish a landing for the boats of the Point Judith life-saving service, which now often can not be effected nearer than Newport or Block Island. I am therefore of the opinion that East Point Judith is worthy of improvement by the General Government, and estimate the cost of a survey of the locality at $300.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184,51. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingstown, by the Rhode Island State census of 1885 was 5,549.

Captain Casey's report is herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., October 12, 1888.

SIR: The following is a report of the preliminary examination of Point Judith Pond and the coast line thence to Point Judith, Rhode Island, with a view to the establishment of harbors of refuge.

On the morning of October 11 the party set out from the upper end of the upper pond in a small steam-launch belonging to Mr. Jeremiah P. Robinson and brother, of Wakefield. A sounding-rod had been provided graduated to feet. Soundings were taken at intervals of about a fifth of a mile. The course lay down the upper pond to the Narrows, thence in a nearly straight course to the interval between Gardiner's Island and a smaller island lying immediately to the eastward, and thence in a gentle curve to High Point.

As indicated on the accompanying map, the soundings taken show that from the upper end of the pond to a point nearly opposite Buf Island, a distance of about 2 miles, a channel depth of about 10 feet can easily be obtained, but from the latter point to the entrance the depth became rapidly less, and in order to obtain sufficient depth of water for commercial purposes, extensive dredging will be necessary.

At a point about one-half mile below High Point the party left the launch because of the eel-grass which impeded the propeller, and took to a flat-bottom skiff. As we approached the entrance along the dotted line on the map it could be seen that there was a perceptible current setting into the pond and into the narrow passage forming its outlet; this current became so strong that headway could be made with difficulty against it. The depth in the narrow tortuous outlet varied from 3 to 8 feet. The tide was at its full, and there was no appearance of a bar at the entrance. As the mean range of the tide on the coast is about 3 feet, and as the known range of the tide in the pond is from 6 to 9 inches, it follows that the low level of the pond can not be much more than 2.5 feet above mean low tide in the ocean, and that if a navigable channel 200 feet wide and 7 feet deep (at midtide) was excavated as indicated on the diagram marked A, the depth in the pond would be reduced by that amount at low tide. By a rough calculation, assuming the area of the pond to be 1¾ square miles, such an outlet as that just indicated would accommodate the incoming and outflowing tide with a current of 3 miles per hour. If a row of guide-piling sheathed with planks be driven along the borders of the artificial channel and cut off at a height of 8 feet above the high-water level, it would serve to retain the current for purposes of deepening the channel, and would at the same time serve as a catch for the loose sand which is sometimes extensively shifted by the wind.

If a harbor of refuge is to be built on the coast to the westward of Point Judith, it would seem that the best location for it would be at the entrance of this pond, where it would serve at once as a harbor of refuge and as a quiet port wherein vessels might discharge cargoes upon lighters, which could then be towed up the pond to Wakefield.

There is no part of the coast between the entrance and Point Judith which could be advantageously chosen as a site for the harbor, because of a long ledge which extends for nearly a mile in a south by easterly direction from a point nearly one-half mile from the shore near the entrance of the pond. This ledge would effectually bar the progress of any vessel drawing more than 13 feet of water, and its attempt to reach such a harbor from the southwest would at all times be dangerous.

The position of the proposed harbor is indicated on the map.

Proceeding to the life saving station at Point Judith, the captain of the crew was asked his opinion as to the position and nature of the proposed breakwater to the north of the point. The position of the breakwater as traced by him is shown on the map, and it was suggested that a small prolongation at right angles to the axis and from its extremity would be very useful, and such a form far superior to the arc of a circle.

If the breakwater be built in this position, it is suggested that it be capped with large, rough-finished stones, so that it could serve some of the purposes of a dock.

On reviewing the entire project, which, although threefold in its nature, is in reality only one, it should be said in conclusion that it is quite possible, and, as far as the Wakefield harbor of refuge and the Point Judith breakwater are concerned, almost a necessity.

Appended (marked B) there is a list of the vessels which have been wrecked on this coast from the Point Judith Pond Inlet to a point midway between the point and Narragansett Pier. It was very obligingly furnished by the captain of the life-saving crew.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

Maj. W. R. LIVERMORE,
Corps of Engineers, U. S. A.

B.—List of vessels wrecked near Point Judith, 1883–'88.

Names wrecked.	When wrecked.	Valuation of vessels.	Valuation of cargo.	Nature.
Schooner Warren Gates.........	Mar. 25, 1883	$4,000	$6,500	Steel wire.
Schooner Thomas R. Pillsbury..	June 13, 1883	28,000	2,500	Coal.
Schooner Julia A. Tate..........	May 10, 1884	4,000	3,500	Log-wood and axles.
Schooner Idlewild................	June 6, 1884	2,000	1,125	Grain.
Schooner Almond Bacon.........	Nov. 5, 1885	3,000	2,000	Iron.
Schooner Mott Haven............	Dec. 25, 1885	6,000	1,900	Furniture and oil.
Schooner Willie De Wolf.........	Dec. 25, 1885	3,000	1,500	Lumber.
Schooner Allen Greene...........	Jan. 9, 1886	12,000	No cargo.	Ballast.
Steamer Miranda	June 20, 1886	110,000	31,500	General cargo.
Schooner Mary Natt.............	Dec. 1, 1886	1,200	2,700	Iron.
Schooner Harry A. Barry........	Feb. 20, 1887	25,000	4,275	Coal.
Schooner Mary A. Drury.........	Dec. 31, 1887	10,000	2,000	Coal.
Brig John Welsh, Jr...............	Mar. 8, 1888	1,500	1,200	Coal.
Schooner Maggie J. Smith.......	Nov. 10, 1887	35,000	5,000	Coal.
Schooner Henry H. Olds.........	Apr. 12, 1888	45,000	5,000	Coal.
Schooner Anita..................	May 2, 1888	3,000	1,800	Lumber.
Schooner Earl P. Mason.........	Aug. 22, 1888	17,000	3,000	Coal.
Schooner Isaac H. Borden........	Sept. 9, 1888	500	3,000	Oil.

Total number of wrecks, 18; total valuation of vessels, $310,200; total valuation of cargo, $78,500.

SURVEY OF COAST NEAR LIFE-SAVING STATION, EAST POINT JUDITH, RHODE ISLAND, WITH A VIEW TO CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 6, 1889.

GENERAL: In compliance with instructions contained in Department letter of April 1, 1889, I have the honor to make the following report of a survey of the coast near life-saving station, East Point Judith, Rhode Island. This survey was completed in the month of July. A report of the preliminary examination of the coast was submitted December 14, 1888.

Point Judith is the southeastern extremity of South Kingstown, Washington County, R. I., and marks the southwestern entrance to Narragansett Bay. Its shores are covered with bowlders, and the remains of a number of wrecks are scattered along the beach on both sides of the point.

The ebb tides from Narragansett Bay, Long Island Sound, and Buzzard's Bay meet southeast of here, and when a heavy wind is blowing from that quarter the smaller class of vessels do not attempt to pass the point; those east of it run into either Newport or Dutch Island harbors, a distance of 12 or 15 miles, while those west of it run for Stonington, Conn., distant 21 miles. The amount of commerce passing this point is considerable, but the larger vessels engaged in the coasting trade pass to the southward of Block Island, only about 10 miles distant, where in heavy storms they lie under the lee of its shores.

In my report of the preliminary examination of the coast near life-saving station, East Point Judith, Rhode Island, I stated that a harbor could be made by building breakwaters at a cost, roughly estimated, at $800,000. Subsequent examination, however, shows that such a harbor could not answer the requirements. A small area could be protected at a considerable cost, but the anchorage would not be good.

Although an examination of the coast immediately west of the point was not required by the act of Congress of August 11, 1888, the survey was extended as far to the westward as the funds would allow. The results of this survey and examination indicate that a harbor could be built here for about $1,250,000 that would be large enough for small vessels, but the bottom is hard and sandy and the current strong.

The position of the breakwater is shown on the sketch.*

The following is the estimated cost of breakwater at Point Judith:

1,100,000 tons of riprap granite, at $1	$1,100,000
Contingencies	150,000
Total	$1,250,000

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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* Omitted; printed in House Ex. Doc. No. 66, Fifty-first Congress, first session.

PRELIMINARY EXAMINATION OF NARRAGANSETT BAY AT THE MOUTH OF NARROW RIVER, RHODE ISLAND, WITH A VIEW OF CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Narragansett Bay at the mouth of Narrow River, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me on the 8th October last.

Narrow River empties into the western side of Narragansett Bay about 6 miles above Point Judith and about 1½ miles northeast of Narragansett Pier. It is in South Kingstown, Washingtown County, R. I.

It connects the waters of Pataquamset River and a cove of the same name with Narragansett Bay.

The former is navigable for small vessels for a distance of about 5 miles to the northward of its junction with Narrow River, about three-fourths of a mile from the mouth of the latter. The cove extends to the southward about 1½ miles and is navigable for flat-boats.

These bodies of water form tidal reservoirs which tend to scour the bottom of Narrow River, the waters from which carry comparatively little sediment. Such shoaling as occurs at the mouth of the river is probably occasioned by the wash of sand from the beach to the southward.

The parties desiring the improvement ask for the construction of a breakwater extending from the beach below the mouth of Narrow River, first in a southeasterly direction for a distance of about 1,200 feet, thence northeasterly, about 300 feet, for the purpose of stopping the movement of the sand along the beach into the mouth of the river. They also propose to build a line of railroad from this harbor to Narragansett Pier, about 1½ miles to the southward, and wharves for landing within the harbor.

The present landing of Narragansett Pier is not available in bad weather, as it is unprotected from the sea, and there is no other landing in the vicinity. It is also controlled by private parties.

The shores in the vicinity are bold and rocky, except to the south, where they are high and cultivated, the sand being protected from the wind by sod.

It is stated that the cost of fuel and building material would be reduced from one-fourth to one-third by the establishment of a harbor wherein vessels could load and unload in safety, and that about 8,000 to 9,000 inhabitants would be benefited by the improvement, both in cheapening the cost of living and facilitating the shipment of their products.

A rough estimate of the cost of a breakwater here is $30,000. I am of opinion that Narragansett Bay at the mouth of Narrow River is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at $300.

Narrow River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Whale Rock Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingstown, by the Rhode Island State census of 1885, was 5,549, and that of North Kingstown was 3,874.

Commercial statistics are hereto appended, and a sketch* showing location of the proposed improvement and one of the neighboring country are herewith inclosed.

Very respectfully, your obedient servant.

W. R. Livermore,
Major of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

COMMERCIAL STATISTICS.

[Furnished by Mr. George N. Kenyon.]

Material landed at Narragansett Pier from June 1, 1887, to October 15, 1888.

Coal	tons,	11,906
Brick	number,	481,000
Corn	bushels,	28,800
Cement	tons,	225
Lime	barrels,	1,829
Lumber	feet,	3,295,000
Shingles	number,	1,159,000
Laths	do.	1,119,000
Railroad iron	tons,	200
Water pipe	do.	220
Oyster shells	do.	220

Besides twelve cargoes containing general merchandise, blue-stone, railroad-ties, etc.

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* Not printed.

SURVEY OF NARRAGANSETT BAY AT THE MOUTH OF NARROW RIVER, RHODE ISLAND, WITH A VIEW OF CONSTRUCTING A BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 6, 1889.

GENERAL: I have the honour to make the following report of survey at the mouth of Narrow River, Rhode Island, a report of the preliminary examination of which was made December 14, 1888.

Department letter of April 1, 1889, notified me that an allotment had been made to defray the expenses of surveys in this district, and as soon thereafter as possible they were commenced. Heavy seas and dense fogs delayed the completion of the survey at this place until the end of June.

Narrow River is about three-quarters of a mile long, and lies in the eastern part of South Kingstown, Washington County, R. I.,* about 6 miles above Point Judith, and acting as an outlet for the waters of Pettaquamscott River and cove, empties into Narragansett Bay at a point about 1¼ miles northeast of Narragansett Pier, a town of considerable importance as a summer watering place. A sandy beach extends from this town northward to the mouth of Narrow River, where the west shore of Narragansett Bay suddenly becomes bold and rocky. Granite of good quality has been quarried from a ledge on the north bank of the river. This ledge serves to protect the entrance to the river from northeast storms, while those from the south carry the sand northward and contract the mouth of the river.

It is thought by those who desire the improvement that a breakwater extending out from a point on the beach south of the entrance will stop the movement of this sand and will afford a sufficient area of smooth water to enable vessels to receive and discharge their cargoes.

Narrow River and its main branch, the Pettaquamscott River, are navigable for about 5¾ miles above the mouth of the former; the cove is navigable for flatboats.

The estimated cost of a breakwater, the position of which is shown on the accompanying map,† marked "A," is $24,000. No further expenditure is recommended, as any improvement here is of doubtful permanence on account of the shifting sand. The requirements of this locality can never demand an extensive harbor, inasmuch as one more than a hundred times as large could be made a few miles to the northward, as shown on the accompanying map,† marked "B," by constructing on the south, at the point marked "*a*," a breakwater at a cost of $150,000, and later, if found necessary, on the north, at the point marked "*b*," another at a cost of $75,000. This would form one of the most perfect seaports in the Northern States, far superior in all respects to Providence, Newport, or Fort Pond at the eastern end of Long Island.

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* It is understood that a district called Narragansett has recently been formed embracing the eastern part of this town.

† Omitted; printed in House Ex. Doc. No 57, Fifty-first Congress, first session.

The following is the estimated cost of breakwater at Narrow River :

44,000 tons of rip-rap granite, at 50 cents	$22,000
Contingencies	2,000
Total	$24,000

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY,

AT ITS

JANUARY SESSION, A. D. 1892.

PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1892.

ANNUAL REPORT

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PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1892.

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e Commissioners,

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submits its Sixteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, reappointed J. Herbert Shedd, of Providence, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

The harbor line on the westerly side of the Pawtucket river opposite land of the Conant Thread Company and land of the Pawtucket Gas Company, southerly of Spencer street, for a distance of 221.07 feet was changed by a resolution of the General Assembly, passed April 29, 1891.

Upon petition, a harbor line was designed on the easterly side of Pawtucket river from Bass Rock below Dunnell's wharf to the Central, or Red, bridge along the Pawtucket and East Providence shores, and a public hearing was given to the several towns and all parties interested on the 28th day of November, 1891. A report upon this line, accompanied by plans, will soon be presented to the General Assembly.

A petition was received from the Old Colony Railroad Company on December 30, 1891, asking that a change be made in the harbor line along their property near India street in Providence. A report upon this matter will soon be presented to the General Assembly.

No definite action has been taken in regard to harbor lines proposed in the south county, one from near Saunderstown to near Bonnet Point and another along the shore opposite the District of Narragansett.

ENCROACHMENT AND DUMPING.

The encroachment upon the Pawtucket river, near the extension of Tockwotton street, to the extent of several thousand yards, caused by the city of Providence in filling the shore contrary to the advice of the Harbor Commissioners, has not yet been removed; but the city is under contract, approved by the Attorney General, to do this, and it is not anticipated that any trouble will be made by the city when the Commissioners request a compliance with the contract. It is intended to ask the city to remove the obstruction at an early day.

Complaints have been made to this board of various minor encroachments which have received the attention of the Commissioners.

Permits have been given, under restrictions, in a few cases for the dumping of limited amounts of dredged material in other places than the common dumping ground below Prudence Island.

The usual care has been required to check obstructions and encroachments, by the dumping of ashes from steamers, unauthorized building from the shores, and in other ways which would, apparently, in the absence of such care, grow into a serious injury in the public waters.

MAKING LAND.

Proposals have been received from the U. S. Engineer in charge, in these waters, looking to the preparation of bulk-heads or other barriers along the channels, behind which the U. S. Government will deposit dredged material without cost to the littoral owners. Some action has been taken by the city of Providence towards availing of this plan for the improvement of the flats from Hill's wharf to Sassafras Point.

DISCHARGE OF OILY SUBSTANCES INTO TIDE.

On the first day of May, 1891, an act was passed prohibiting the discharge, or allowing to escape, into the waters of the Providence or Warren rivers any material from the making of gas which may cause disagreeable odors or defile the surface of vessels, or other property, or the shores, or injure the healthy growth of fish or shell-fish.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters as follows:—

No. 140. January 21, to the estate of Alexander Duncan to drive piles and repair a wharf at the foot of Peck street in Providence.

No. 141. April 7, to the New York, Providence and Boston Railroad Company to drive piles, repair and make additions to wharf at Wilkesbarre Pier in East Providence.

No. 142. April 24, to the Rhode Island Lumber Company to drive piles and repair the Manchester wharf on the west side of Providence river south of Point street in Providence.

No. 143. June 10, to the New York, Providence and Boston Railroad Company to drive piles to strengthen the foundations for coal pocket at Harbor Junction wharf on the west side of Providence river in Providence.

No. 144. August 5, to the Rocky Point Oyster Company to extend their wharf east of Gano street, on Wickenden street, on the Seekonk river, in Providence.

No. 145. August 12, to the Pawtucket Gas Company to extend their wharf and build a retaining wall on Tidewater street in Pawtucket.

No. 146. June 17, to the city of Providence to construct a sewer outlet on the west bank of the Seekonk river opposite Blackstone Park in Providence.

No. 147. August 26, to the New York, Providence and Boston Railroad Company to fill in with earth the pile trestle approach to the Harbor Junction Pier in the city of Providence.

No. 148. November 11, to Augustus W., George A. and John E. Bourne to build a bank wall and bridge wharf at the corner of Gano and Wickenden streets on Seekonk river in Providence.

No. 149. December 16, to Thomas J. Hill to repair his wharf on the west side of Providence river at the foot of Crary street in Providence.

No. 150. December 30, to the Providence Corinthian Yacht Club to build a platform as a foundation for a club house, and to drive piles, in front of Allen's avenue, between Seymour street and Pleasant street in Providence.

Permission was also given on the third day of June to the Continental Steamboat Company to connect two wharves at Riverside.

Assent has been given as follows:—

1. April 7, to Moulton, O'Mahoney & Trumbull to drive piles for temporary use near Field's Point.
2. August 12, to Seth H. Brownell to build a bridge wharf at Warwick Neck on shore of estate of George H. Dart.
3. August 19, to George B. Boyden to build a bridge across Bullock's Cove from Crescent Park to Richmond Point.
4. August 19, to Richard W. Comstock to build a wharf at Warwick Neck in Kent county.
5. September 9, to Moulton, O'Mahoney & Trumbull to drive piles for temporary use to guide the lowering of pipes for outfall sewer at Field's Point.
6. September 30, to J. W. Auchincloss to build a wharf on his property south of Fort Adams, on the outer harbor, in Newport.

WORK UNDER U. S. ENGINEER

By the courtesy of Captain William H. Bixby, Corps of Engineers, we have been furnished with a copy of the annual report to the Chief of Engineers, U. S. A., for 1891, upon the work of which he is now in charge, from which we have made extracts in relation to the work in Rhode Island waters, which will be found in the appendix. Captain

Bixby has also furnished to us a statement of the work done under his direction since the date of the annual report, to December 31, 1891, a copy of which will be found in the appendix.

Respectfully Submitted,

J. HERBERT SHEDD,
H. C. BRADFORD,
W. C. CLARKE,
Harbor Commissioners.

APPENDIX A.

ENGINEER OFFICE, U. S. ARMY.
NEWPORT, R. I. April 29, 1892.

Chairman, Harbor Commissioners, State of Rhode Island, 2 *Market Square, Providence, R. I.*

SIR: In continuation of my letter of the 28th instant, and in further answer to yours of the 27th instant, I have to give you herewith a brief summary of the work from 30th of June to 31st Dec. 1891 upon the various Rhode Island rivers and harbors in my district.

PAWTUCKET RIVER, R. I.

The channel was completed to its full width of 100 feet and depth of 12 feet at mean low water, from Dunnell's Wharf to a line opposite the Gas Co's wharf; and dredged to a width of 40 feet and depth of 12 feet from the Gas Co.'s wharf to the lower end of Grant & Co.'s wharf.

PROVIDENCE RIVER, R. I.

The projected anchorage area in the Fox Point reach and about eight-tenths of the 20-foot anchorage area of the Sassafras Point reach were completed.

GREEN JACKET SHOAL, PROVIDENCE RIVER, R. I.

The area dredged to 25 feet at mean low water was extended by about four and six-tenths acres, about two-thirds of which was to the southward and one-third to the eastward of the part already dredged.

BLOCK ISLAND HARBOR, R. I.

The north wall of the enlarged inner harbor was extended to the westward so that upon the cessation of work 195 feet of the wall west of the entrance into the harbor had been completed, an additional 65 feet built up to the level of high water, 145 feet up to within one foot of high water, and the foundation course laid for about 150 feet further.

HARBOR OF REFUGE AT POINT JUDITH, R. I.

8,596 tons of riprap stone were placed in the breakwater near the beacon marking its southwestern angle.

PAWCATUCK RIVER, R. I.

The channel, to the full width of 100 feet and depth of 8 feet, was extended about 1,900 feet upward towards Westerly so as to reach to within about 1300 feet of the lower wharves of the city; and then continued, with a width of 40 feet, up 300 feet beyond these lower wharves; in addition which two cuts 20 feet wide and about 100 feet long each were made above the 40 foot channel.

On all other Rhode Island rivers and harbors, all work was stopped prior to 30th June, 1891, further work being postponed to await further appropriations.

Very respectfully,

W. H. BIXBY,
Captain of Engineers.

APPENDIX B.

EXTRACT FROM REPORT OF MAJOR WILLIAM R. LIVERMORE TO CHIEF OF ENGINEERS, U. S. A., FOR 1891.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 28,000 and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draft can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The total amount expended up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $167,005.96. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in

1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge a distance of about 12,740 feet, and with a width of 60 feet and of the same depth for an additional distance of about 2,000 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about 1¼ miles of the head of navigation, and a channel 60 feet wide and of the same depth from Bass Rock to a line about 200 feet above Dunnell's Wharf.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

OPERATIONS DURING THE LAST FISCAL YEAR.

By act of September 19, 1890, Congress appropriated $30,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates continuing the excavation of the channel toward Pawtucket, affording at the same time such relief as the commerce may require at the shoalest places above the main work, and the commencement of work on the ledge in the channel off Pawtucket.

Advertisements for proposals for dredging were issued November 21, 1890, and the proposals opened December 22, 1890. All were rejected, and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. These were also rejected.

Abstracts of proposals received under both the above advertisements will be found in the appended table.

Preparations have been made for carrying on the work by hired labor. Two Government dredges and five scows will soon be ready for the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Co.'s Wharf, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet,

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to extending the channel toward Pawtucket by dredging, and to commencing work on the ledge.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $328,849.56. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1890, balance unexpended	$656 05
Received by Treasury settlement	19 95
Amount appropriated by act approved September 19, 1890	30,000 00
	30,676 00
June 30, 1891, amount expended during fiscal year	12,128 02
July 1, 1891, balance unexpended	18,547 98
July 1, 1891, outstanding liabilities	307 48
July 1, 1891, balance available	18,240 50
Amount (estimated) required for completion of existing project	337,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S Army, Newport, Rhode Island, in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.
1	Elijah Brainard, New York, N. Y	$11 75	$0 33
2	Edgar M. Payn, Albany, N. Y	18 50	.37 9-10
3	Henry Du Bois Sons, New York, N. Y	20 00	.38
4	Geo. W. Townsend, Boston, Mass	9 00	....

Received in response to advertisement dated March 5, 1891. Proposals opened at 12 o'clock, noon, Wednesday. March 25, 1891.

[To be commenced May 1 and finished December 31, 1891.]

1	Elijah Brainard, New York, N. Y	$11 75	$0 32¼
	Elijah Brainard, New York, N. Y	11 75	* 29½
2	Edgar M. Payn, Albany, N. Y	15 00	31

* If work is commenced September 1, 1891, and finished June 30, 1892.]

COMMERCIAL STATISTICS.

[Furnished by Mr. Geo. E. Newell, Pawtucket, R. I.]

Receipts.

Articles.	1890.	1891.	Articles.	1890.	1891.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Coal	121,594	140,765	N. R. stone	116	253
Lumber	2,777	6,423	Spool wood	450	238
Pickets	31	…………	Iron	505	350
Laths	101	418	Fertilizer material	100	130
Shingles	39	95	Acid phosphate	175	…………
Bricks	3,838	54,405	Potash	150	130
Lime	591	540	Gravel,	262	466
Cement	495	1,469	Cotton	51	127
Fire-clay	5	…………			

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.84 in deepening the channel; first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing size of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Fields Points of the following dimensions in cross sections, viz.:

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of the Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $283,600.63. At that date the 25-foot channel, 300 feet wide, had been completed. Bulkhead Rock had been removed. The excavation of the 20-foot anchorage area has been completed in Fox Point Reach, and of the same areas in the Sassafras Point and the Fields Point reaches, about three-fourths and one-half respectively, had been finished.

The 18-foot area on the east side of Fox Point, and about three-fourths of the 18-foot area on the same side of Sassafras Point Reach had also been finished.

OPERATIONS DURING THE LAST FISICAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $50,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers.

The project contemplates, first, the completion of the entire anchorage area in the Fox Point Reach, and, second, the expenditure of the remaining funds towards the completion of the anchorage area in Sassafras Point Reach, beginning with the unfinished portion of the 20-foot area; and if funds remain, dredging in the 18, 12, and 6 foot areas, in the order named.

Advertisements for proposals for dredging under this project were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. Abstracts of proposals received under both the above advertisements and the terms of the contract will be found in the appended tables.

Work under this contract was commenced April 29, 1891, and was in progress at the close of the fiscal year; 140,678 cubic yards had been excavated up to June 30, 1891, completing the 18, 12, and 6 foot areas on the west side of the Fox Point Reach.

Work was also commenced on the 12-foot area on the east side of the same reach.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to continue the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $828,849.56. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1890, balance unexpended..................................	$887 56
Amount appropriated by act approved September 19, 1890..........	50,000 00
	50,887 56
June 30, 1891, amount expended during fiscal year.................	24,678 39
July 1, 1891, balance unexpended...............	26,209 17

July 1, 1891, outstanding liabilities	$10,389 74	
July 1, 1891, amount covered by uncompleted contracts	10,789 43	
		21,189 17
July 1, 1891, balance available		5,070 00
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		115,000 00

Submitted in compliance with the requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Providence River and Green Jacket Shoal, Providence Harbor, Rhode Island, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Price per cubic yard.
1	Henry Dubois's Sons, New York	$0 09½

Received in response to advertisement dated March 5, 1891, opened March 25, 1891.

[To be commenced March 15, 1891, and finished December 31, 1891.]

No.	Name and address of bidder.	Price per cubic yard.
1	Charles and Henry E. Du Bois, New York	$0 09
2	Atlantic Dredging Company, New York	09 4-10

Contract awarded to C. and H. E. Du Bois, with approval of Chief of Engineers.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Foreign Imports.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Lumber	3,632	9,252	Rubber	....	152
Shingles	657	1,600	Ice	509	....
Laths	1,407	1,787	Wool	3,815	10
Wood	1,166	....	Starch	149	....
Logwood	3,821	3,277	Lime	121	....
Pickets	54	815	Potatoes	108	....
Piling	812	958	Liquors	14	13
Brimstone	590	157	Tobacco	½	....

By water and rail.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Cotton	55,105	42,298	Lumber	....	112,688
Wool	12,388	....	Flour	28,668	29,525
Coal	1,054,314	864,925	Grain	44,478	78,227
Iron and Steel	65,876	62,664	Dry Goods	5,266	....
Oil	24,003	21,632	Print Cloths	2,616	2,270
Waste	5,811	2,864	Chemicals	3,343	....
Beef	12,486	10,942	Liquors	9,553	190

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres.

There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side, a width of 300 feet and a depth of 20 feet, and the one on the south side, a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, vol. I, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended, including outstanding liabilities, to June 30, 1890, was $54,250. The result was the excavation to a depth of 25 feet at mean low water of an area of about 13¾ acres, extending along the northern and western sides of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of Nov 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $25,000 for continuing this work, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project provides for the continuation of the dredging to the east and south of the area already excavated.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. These were all rejected.

The work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. An abstract of proposals received under both the above advertisements and the terms of the contract will be found in the tables appended to report on improvement of Providence River, Rhode Island, page 714.

The Government plant has been increased by the construction of large dump scows.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remainder of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for to continuing the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

For the Commercial statistics, see Report of the Improvement of Providence River and Narragansett Bay, Rhode Island.

MONEY STATEMENT.

July 1, 1890, balance unexpended		$23 50
Received by Treasury settlement		10 07
Amount appropriated by act approved September 19, 1890		25,000 00
		25,033 57
June 30, 1891, amount expended during fiscal year		10,780 13
July 1, 1891, balance unexpended		14,253 44
July 1, 1891, outstanding liabilities	$332 44	
July 1, 1891 amount covered by uncompleted contracts	11,700 00	
		12,032 44
July 1, 1891, balance available		2,221 00
Amount (estimated) required for completion of existing project		33,096 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		33,096 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

IMPROVEMENT OF GREENWICH BAY, RHODE ISLAND.

Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

The channel leading to the town of East Greenwich was deep enough for the present demands of commerce, but so crooked as to render navigation difficult. This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $2,000 for widening the channel.

PLAN OF IMPROVEMENT.

The improvement contemplated was the straightening and widening of the channel by the removal of sand bars and shoals.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work a project for the expenditure of the funds was prepared and was approved by the Chief of Engineers. The project provided for dredging to a depth of 10 feet at mean low water on the western edge of the bar extending out from Long Point, carrying the work to the eastward as far as the funds would permit. Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected. An abstract of the proposals received will be found in the appended table.

Work was commenced April 10, 1891, with the dredge *Texas*, tug *Sargon*, and scows, all belonging to the United States. The *Sargon* was required for other work and was transferred April 17, and replaced by a hired tug.

Nineteen thousand five hundred and ninety-two cubic yards were excavated during the year, and the result was the completion of the project, by cutting off the bar extending out from Long Point, about 210 feet. The channel was widened for a distance of about 500 feet.

Mr. C. O. Abell was the local superintendent.

The project being completed, no work is anticipated for the coming year.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $328,849.56. The nearest fortification is the fort at Dutch Island, Rhode Island. The nearest light-house is Warwick Light.

MONEY STATEMENT.

Amount appropriated by act approved September 19, 1890..........	$2,000 00
June 30, 1891, amount expended during fiscal year................	1,896 08
July 1, 1891, balance unexpended..................................	103 92
July 1, 1891, outstanding liabilities................................	92 92
July 1, 1891, balance available....................................	11 00

1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge a distance of about 12,740 feet, and with a width of 60 feet and of the same depth for an additional distance of about 2,000 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about 1¼ miles of the head of navigation. and a channel 60 feet wide and of the same depth from Bass Rock to a line about 200 feet above Dunnell's Wharf.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

Operations During the Last Fiscal Year.

By act of September 19, 1890, Congress appropriated $30,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates continuing the excavation of the channel toward Pawtucket, affording at the same time such relief as the commerce may require at the shoalest places above the main work, and the commencement of work on the ledge in the channel off Pawtucket.

Advertisements for proposals for dredging were issued November 21, 1890, and the proposals opened December 22, 1890. All were rejected, and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. These were also rejected.

Abstracts of proposals received under both the above advertisements will be found in the appended table.

Preparations have been made for carrying on the work by hired labor. Two Government dredges and five scows will soon be ready for the work.

Work Required to Complete the Existing Project.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Co.'s Wharf, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet,

Operations Contemplated for the Fiscal Year Ending June 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to extending the channel toward Pawtucket by dredging, and to commencing work on the ledge.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $328,849.56. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

MONEY STATEMENT.

July 1, 1890, balance unexpended	$656 05
Received by Treasury settlement	19 95
Amount appropriated by act approved September 19, 1890	30,000 00
	30,676 00
June 30, 1891, amount expended during fiscal year	12,128 02
July 1, 1891, balance unexpended	18,547 98
July 1, 1891, outstanding liabilities	307 48
July 1, 1891, balance available	18,240 50
Amount (estimated) required for completion of existing project	337,478 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S Army, Newport, Rhode Island, in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.
1	Elijah Brainard, New York, N. Y	$11 75	$0 33
2	Edgar M. Payn, Albany, N. Y	18 50	.37 9-10
3	Henry Du Bois Sons, New York, N. Y	20 00	.38
4	Geo. W. Townsend, Boston, Mass	9 00	....

Received in response to advertisement dated March 5, 1891. Proposals opened at 12 o'clock, noon, Wednesday. March 25, 1891.

[To be commenced May 1 and finished December 31, 1891.]

1	Elijah Brainard, New York, N. Y	$11 75	$0 33¼
	Elijah Brainard, New York, N. Y	11 75	* 29½
2	Edgar M. Payn, Albany, N. Y	15 00	31

* If work is commenced September 1, 1891, and finished June 30, 1892.]

COMMERCIAL STATISTICS.

[Furnished by Mr. Geo. E. Newell, Pawtucket, R. I.]

Receipts.

Articles.	1890.	1891.	Articles.	1890.	1891.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Coal	121,594	140,765	N. R. stone	116	253
Lumber	2,777	6,423	Spool wood	450	238
Pickets	31	....	Iron	505	350
Laths	101	418	Fertilizer material	100	130
Shingles	39	95	Acid phosphate	175	....
Bricks	3,838	54,405	Potash	150	130
Lime	591	540	Gravel,	262	466
Cement	495	1,469	Cotton	51	127
Fire-clay	5	....			

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel; first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing size of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Fields Points of the following dimensions in cross sections, viz.:

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of the Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $283,600.63. At that date the 25-foot channel, 300 feet wide, had been completed. Bulkhead Rock had been removed. The excavation of the 20-foot anchorage area has been completed in Fox Point Reach, and of the same areas in the Sassafras Point and the Fields Point reaches, about three-fourths and one-half respectively, had been finished.

The 18-foot area on the east side of Fox Point, and about three-fourths of the 18-foot area on the same side of Sassafras Point Reach had also been finished.

OPERATIONS DURING THE LAST FISICAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $50,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers.

The project contemplates, first, the completion of the entire anchorage area in the Fox Point Reach, and, second, the expenditure of the remaining funds towards the completion of the anchorage area in Sassafras Point Reach, beginning with the unfinished portion of the 20-foot area; and if funds remain, dredging in the 18, 12, and 6 foot areas, in the order named.

Advertisements for proposals for dredging under this project were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. Abstracts of proposals received under both the above advertisements and the terms of the contract will be found in the appended tables.

Work under this contract was commenced April 29, 1891, and was in progress at the close of the fiscal year; 140,678 cubic yards had been excavated up to June 30, 1891, completing the 18, 12, and 6 foot areas on the west side of the Fox Point Reach.

Work was also commenced on the 12-foot area on the east side of the same reach.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to continue the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $328,849.56. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1890, balance unexpended	$887 56
Amount appropriated by act approved September 19, 1890	50,000 00
	50,887 56
June 30, 1891, amount expended during fiscal year	24,678 39
July 1, 1891, balance unexpended	26,209 17

July 1, 1891, outstanding liabilities	$10,339 74	
July 1, 1891, amount covered by uncompleted contracts	10,789 43	
		21,189 17
July 1, 1891, balance available		5,070 00
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		115,000 00

Submitted in compliance with the requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Providence River and Green Jacket Shoal, Providence Harbor, Rhode Island, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Price percubic yard.
1	Henry Dubois's Sons, New York	$0 09⅛

Received in response to advertisement dated March 5, 1891, opened March 25, 1891.

[To be commenced March 15, 1891, and finished December 31, 1891.]

No.	Name and address of bidder.	Price per cubic yard.
1	Charles and Henry E. Du Bois, New York	$0 09
2	Atlantic Dredging Company, New York	09 4-10

Contract awarded to C. and H. E. Du Bois, with approval of Chief of Engineers.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Foreign Imports.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Lumber	3,632	9,252	Rubber	....	152
Shingles	657	1,600	Ice	509	....
Laths	1,407	1,787	Wool	3,815	10
Wood	1,166	....	Starch	149	....
Logwood	3,321	3,277	Lime	121	....
Pickets	54	815	Potatoes	108	....
Piling	812	958	Liquors	14	13
Brimstone	590	157	Tobacco	½	....

By water and rail.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Cotton	55,105	42,298	Lumber	....	112,683
Wool	12,388	....	Flour	28,668	29,525
Coal	1,054,314	864,925	Grain	44,478	78,227
Iron and Steel	65,876	62,664	Dry Goods	5,266	....
Oil	24,003	21,632	Print Cloths	2,616	2,270
Waste	5,811	2,864	Chemicals	3,343	....
Beef	12,486	10,942	Liquors	9,553	190

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres.

There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side, a width of 300 feet and a depth of 20 feet, and the one on the south side, a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, vol. I, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended, including outstanding liabilities, to June 30, 1890, was $54,250. The result was the excavation to a depth of 25 feet at mean low water of an area of about 13¾ acres, extending along the northern and western sides of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of Nov 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $25,000 for continuing this work, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project provides for the continuation of the dredging to the east and south of the area already excavated.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. These were all rejected.

The work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. An abstract of proposals received under both the above advertisements and the terms of the contract will be found in the tables appended to report on improvement of Providence River, Rhode Island, page 714.

The Government plant has been increased by the construction of large dump scows.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remainder of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for to continuing the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

For the Commercial statistics, see Report of the Improvement of Providence River and Narragansett Bay, Rhode Island.

MONEY STATEMENT.

July 1, 1890, balance unexpended		$23 50
Received by Treasury settlement		10 07
Amount appropriated by act approved September 19, 1890		25,000 00
		25,033 57
June 30, 1891, amount expended during fiscal year		10,780 13
July 1, 1891, balance unexpended		14,253 44
July 1, 1891, outstanding liabilities	$332 44	
July 1, 1891 amount covered by uncompleted contracts	11,700 00	
		12,032 44
July 1, 1891, balance available		2,221 00
Amount (estimated) required for completion of existing project		33,096 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		33,096 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

IMPROVEMENT OF GREENWICH BAY, RHODE ISLAND.

Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

The channel leading to the town of East Greenwich was deep enough for the present demands of commerce, but so crooked as to render navigation difficult.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $2,000 for widening the channel.

PLAN OF IMPROVEMENT.

The improvement contemplated was the straightening and widening of the channel by the removal of sand bars and shoals.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work a project for the expenditure of the funds was prepared and was approved by the Chief of Engineers. The project provided for dredging to a depth of 10 feet at mean low water on the western edge of the bar extending out from Long Point, carrying the work to the eastward as far as the funds would permit. Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected. An abstract of the proposals received will be found in the appended table.

Work was commenced April 10, 1891, with the dredge *Texas*, tug *Sargon*, and scows, all belonging to the United States. The *Sargon* was required for other work and was transferred April 17, and replaced by a hired tug.

Nineteen thousand five hundred and ninety-two cubic yards were excavated during the year, and the result was the completion of the project, by cutting off the bar extending out from Long Point, about 210 feet. The channel was widened for a distance of about 500 feet.

Mr. C. O. Abell was the local superintendent.

The project being completed, no work is anticipated for the coming year.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $828,849.56. The nearest fortification is the fort at Dutch Island, Rhode Island. The nearest light-house is Warwick Light.

MONEY STATEMENT.

Amount appropriated by act approved September 19, 1890	$2,000 00
June 30, 1891, amount expended during fiscal year	1,896 08
July 1, 1891, balance unexpended	103 92
July 1, 1891, outstanding liabilities	92 92
July 1, 1891, balance available	11 00

Abstract of proposals for dredging at Greenwich Bay, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn	$0 18
2	Henry Du Bois Sons, New York, N. Y	19
3	Chas. M. Cole, Fall River, Mass	24½

COMMERCIAL STATISTICS.

[Furnished by Mr. Joseph Dews.]

Receipts for 1890.

	Tons.
Coal (about)	15,000
Lumber (about)	5,000

IMPROVEMENT OF COVE AND WATER-WAY NEAR COASTER HARBOR ISLAND, RHODE ISLAND.

This cove is situated in the northwestern part of the city of Newport, R. I., near the southeastern extremity of Coaster Harbor Island, which is occupied by the U. S. Navy as a training station. A causeway connecting Coaster Harbor Island with Rhode Island forms the northern boundary of the cove and separates it from the water way above. This causeway having but one small opening has checked the flow of water around the island and caused deposits, so filling the water way as to cause it to give forth unhealthy and disagreeable odors.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $5,500 for improving the cove and water way.

PLANS OF IMPROVEMENT.

The projected improvement is to dredge the cove to the necessary depth, and to increase the flow of water by larger openings in the causeway, so that garbage and waste thrown into the water will be carried away by the current.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work, a project for the expenditure of the available funds was prepared and was approved by the Chief of Engineers. The project contemplates deepening by 3 feet as much of the cove as the funds permit and making two additional openings in the causeway, spanned by two bridges.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected. An abstract of proposals received will be found in the appended table.

Work was commenced February 6, 1891, with dredge *Texas*, tug *General Warren*, and scows belonging to the United States, and was suspended April 1, 1891, the *General Warren* having been replaced in the meantime by the tug *Sargon*, also Government property; 31,281 cubic yards were excavated, completing the dredging contemplated by the project.

The bridges are framed and ready to put in position in a short time.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

To complete the existing project it is only necessary to cut the causeway and erect the bridges.

Coaster Harbor Island is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91. The nearest light-house is Gull Rock Light. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

Amount appropriated by act approved September 19, 1890	$5,500 00
June 30, 1891, amount expended during fiscal year	2,266 97
July 1, 1891, balance unexpended	3,233 03
July 1, 1891, outstanding liabilities	138 03
July 1, 1891, balance available	3,095 00

Abstract of proposals for dredging at Cove, Coaster Harbor Island, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock, noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before February 1, 1891, and completed by April 1, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn.	$0 19
2	Henry Du Bois Sons, New York, N. Y.	0 20
3	J. H. Fenner, Jersey City, N. J.	0 21¼
4	Charles M. Cole, Fall River, Mass.	0 27¼

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during the summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications under which we are now working are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Vol. I, Page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities at that date, was $120,202.03, with the following results:

The area to be dredged to 13 feet within the harbor had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds had been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1891, Congress appropriated $12,500 for continuing the improvement.

A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project provides for the completion of the 15-foot channel by dredging the remainder of the strip along the western edge north of the dolphin; for dredging in the 10-foot anchorage area, and, if necessary, for the construction of an additional jetty on the west end of Goat Island. Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. An abstract of the proposals received and the terms of the contract will be found in the appended tables.

Work under this contract commenced February 7, 1891, and was finished April 18, 1891. Thirty-four thousand eight hundred and forty-six cubic yards were excavated in the areas specified by the project, and the result was the dredging of the strip along the western edge of the 15-foot channel north of the dolphin and the excavation of about 6 acres of the 10-foot anchorage area.

Mr. J. R. Easton was inspector of the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the 10-foot anchorage area within the harbor and the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the funds asked for to the completion of the existing project.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

MONEY STATEMENT.

July 1, 1890, balance unexpended	$11 68
Received by Treasury settlement	5 09
Amount appropriated by act approved September 19, 1890	12,500 00
	12,516 77
June 30, 1891, amount expended during fiscal year	11,200 89
July 1, 1891, balance unexpended	1,315 88
July 1, 1891, outstanding liabilities	1,295 88
July 1, 1891, balance available	20 00
Amount (estimated) required for completion of existing project	27,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	27,500 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890.

[To be commenced on or before March 15, 1891, and completed not later than December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn.	$0.20⅜
2	J. H. Fenner, Jersey City, N. J.	.21⅛

Contract awarded to Hartford Dredging Company, with the approval of the Chief of Engineers, and dated January 22, 1891.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

Receipts.

Articles.	1889.	1890.	1891.	Articles.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
Lumber	19,749	18,855	20,563	Drain pipe	....	5,000	4,500
Shingles	704	950	997	Sand and gravel	....	10,000	12,000
Laths	1,294	1,062	1,310	Flagstone	....	1,000	1,000
Coal	50,000	50,000	50,000	Granite	....	20,000	25,000
Lime	2,550	2,250	2,250	Iron	....	2,000	2,000
Cement	1,950	1,650	1,650	Ashes	....	41	49
Brick	18,000	18,800	18,000	Fish	....	2,000	3,000
Hay	1,500	5,000	7,000	Potatoes	....	1,800	3,000
Grain	1,200	1,800	1,500	Plaster	....	375	500
Cordwood	....	1,250	1,500	Hair	....	200	200
Marble	....	1,500	3,500				

Shipping.

Years.	Arrival of vessels from foreign ports.		Vessels owned in Newport.	
	Number.	Value of Cargoes.	Number.	Gross tonnage.
1889	29	$16,271 92	143	7,694.54
1890	19	17,398 59	148	7,972.98
1891	25	17,786 90	146	11,390.89

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingstown, R. I., and marks the southwestern entrance to Narragansett Bay. Its shores are covered with bowlders, and a number of wrecks are scattered along the beach on each side of the point. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1¼ miles west of the point.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $75,000 for a National Harbor of Refuge at Point Judith.

PLAN OF IMPROVEMENT.

It is proposed to construct breakwaters along the course of Squid Ledge, mentioned above, and between the southern extremity of the ledge and Point Judith.

A plat of the locality was published in House Ex. Doc. No. 66, Fifty-first Congress, first session.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work, a project for the expenditure of the available funds was prepared and was approved by the Chief of Engineers. The project provides for commencing the work on the outer end of Squid Ledge, and extending the one arm to the north, and the other to the east, with a view to securing a sheltered area for the vessels engaged on the work.

Advertisements for proposals for furnishing and placing riprap granite were issued December 5, 1890, and proposals opened January 5, 1891. All were rejected. An abstract of bids received will be found in the appended tables.

The work was commenced February 13, 1891, by establishing a beacon at the angle of the breakwater, and a portion of the two arms above referred to was built. Work was in progress at the close of the fiscal year.

The capacity of the quarry at Mason Island has been increased to about 400 tons per day, and a Government tug and barge have been prepared for this work. A powerful steamer and five barges have been chartered for the summer and fall.

In this exposed situation it is proposed to take advantage of favorable weather during these seasons for putting stone in the work. About 3,000 tons have been already placed in the arms above referred to, in addition to the stone required for the beacon, which has been maintained to mark the position of the submerged stone since the commencement of the work. Mr. Wm. Babcock Poland is the local superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to finish the construction of the breakwaters.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for, $300,000, to continuing the construction of the breakwaters.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingstown by the Rhode Island State census of 1885 was 5,549.

MONEY STATEMENT.

Amount appropriated by act approved September 19, 1890..	$75,000 00
June 30, 1891, amount expended during fiscal year.................	24,671 15
July 1, 1891, balance unexpended....................	50,328 85
July 1, 1891, outstanding liabilities................................	6,028 85
July 1, 1891, balance available......................	44,300 00
Amount (estimated) required for completion of existing project.....	1,175,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1893............................	300,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing and placing riprap granite in the breakwater at Point Judith, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to an advertisement dated December 5, 1890, and opened at 12 o'clock, noon, on Monday, the 5th day of January, 1891.

[To be commenced on or before March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn.....................	$1 85
2	Francis H. Smith, New York, N. Y...	2 69

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the enlargement of the inner harbor. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, vol. 1, pages 612, 618.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The total expenditure up to June 30, 1890, including liabilities outstanding at that date, was $354,125.59.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor, and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been completed. The timber jetty filled with stone, forming the shore end of the western wall of the enlarged inner harbor, and about 160 feet of its north wall east of the opening into the harbor had been finished, and about 140 feet of the wall west of the opening built to the level of mean high water. The shoal west of the breakwater had been dredged to 9 feet at mean low water from the steamboat wharf to within 100 feet of the north wall.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $15,000 for the continuation of this work, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates continuing the construction of the riprap walls of the enlarged inner harbor.

Advertisements for proposals for riprap granite were issued December 5, 1890, and proposals opened January 5, 1891. But one bid was received, and this was rejected.

An abstract of the proposals received will be found in the appended table.

Work was resumed on the north wall of the enlarged inner harbor and 3,711 tons of riprap granite were placed in it. The result was the extension of the north wall of the enlarged inner harbor to the westward, the foundation reaching to within 50 feet of the end. The stone delivered was taken from Mason Island Quarry, which is operated by the Government.

Mr. F. I. Angell was the local superintendent of the work.

WHARF AT BLOCK ISLAND.

By act of September 19, 1890, the wharf on the land side of the inner harbor was conveyed to the town of New Shoreham "for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States or freight carried in such vessels."

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, and the enlargement of the inner harbor.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for, $24,000, to the continuation of the work according to the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected in Newport in the last fiscal year was $1,878.91. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

MONEY STATEMENT.

July 1, 1890, balance unexpended	$2,171 48
Amount appropriated by act approved September 19, 1890	15,000 00
	17,171 48
June 30, 1891, amount expended during fiscal year	7,726 45
July 1, 1891, balance unexpended	9,445 03
July 1, 1891, outstanding liabilities	4,861 03
July 1, 1891, balance available	4,584 00
Amount (estimated) required for completion of existing project	24,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	24,000 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing and placing riprap granite in the north wall of the inner harbor at Block Island, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement issued December 5, 1890, and opened at 12 o'clock noon, on Monday, the 5th day of January, 1891.

[To be commenced not later than March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn.	$1 80

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Imports and exports.

Article.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*
Coal received (about)	5,500	6,200	6,500
Iron received (about)	275	300	300
Grain received (about)	2,325	2,400	496
Lumber received (about)	5,592	5,722	5,850
General merchandise, not included in the above	15,500	16,200	16,500

Arrivals and departures.

	1888.	1889.	1890.
Steamers	2,200	2,400	2,550
Sailing vessels	116,000	117,000	117,400

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.80 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water.

PLAN OF IMPROVEMENT.

By means of appropriations made in the years 1871–1875, the river was improved by the United States by the excavation of a channel of 5½ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet between the lower and the upper wharves also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, Part I, pages 623-625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the present project up to June 30, 1890, including liabilities outstanding, was $20,862.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the upper end of Major Island and the removal to a depth of 8 feet at mean low water of the ledges at Certain Draw Point and Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $16,600 for the completion of this improvement. A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project contemplates the extension of the channel, 100 feet wide and 8 feet deep, from the upper end of the work to Westerly and from the lower to the upper wharves with a width of 40 feet and depth of 8 feet.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. An abstract of proposals received and the terms of the contract will be found in the appended tables. Work was commenced under this contract April 28, 1891, and was in progress at the end of the fiscal year. Seventeen thousand three hundred and sixteen cubic yards of sand and gravel were dredged, extending the channel about 1,000 feet toward Westerly.

Mr. A. H. Dickens is the local inspector.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and a width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town.

Operations Contemplated for the Fiscal Year ending June 30, 1892.

It is proposed to complete the work.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $828,849.56; Stonington, $1,808.18. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money Statement.

July 1, 1890, balance unexpended		$482 04
Received by Treasury settlement		13 08
Amount appropriated by act approved September 19, 1890		16,600 00
		17,095 12
June 30, 1891, amount expended during fiscal year		6,260 43
July 1, 1891, balance unexpended		10,834 69
July 1, 1891, outstanding liabilities	$3,286 05	
July 1, 1891, amount covered by uncompleted contracts	3,663 64	
		6,949 69
July 1, 1891, balance available		3,885 00

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, unless otherwise agreed in writing, and completed by December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn	$0.21
2	J. H. Fenner, Jersey City, N. J	.28
3	Edgar W. Payn, Albany, N. Y	.35 9-10

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxon & Co., Westerly, R. I.]

Receipts.

Articles.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*
Coal	18,894	17,014	16,681
Sand	892	1,275	1,255
Lumber	5,399	5,256	5,575
Bricks	2,391	702	2,343
Grain	2,180	2,180	1,838
Iron	925	1,094	1,675

Shipments.

Stone	2,180	4,664	4,664
Lumber	....	107	....

Number of passengers carried by steamers in 1890, 33,100.

PRELIMINARY EXAMINATION OF NARRAGANSETT BAY CHANNEL, RHODE ISLAND, BETWEEN STARVE GOAT ISLAND AND THE MAINLAND, WITH A VIEW OF DEEPENING THE SAME.

[Printed in House Ex. Doc. No. 173, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
WASHINGTON, D. C., January 14, 1891.

SIR—I have the honor to submit the accompanying copy of report, dated December 19, 1890, from Maj. W. R. Livermore, Corps of Engineers, giving results of preliminary examination of Narragansett Bay Channel, Rhode Island, "between Starve Goat Island and the Mainland, with a view of deepening the same," made to comply with provisions of the river and harbor act approved September 19, 1890.

Major Livermore reports that this improvement can not be regarded as of great benefit to the general commerce of the country, and, therefore, not worthy of being made by the General Government. Col. H. L. Abbot, Corps of Engineers, division engineer, northeast division, concurs in his opinion, and the views of these officers meet with my approval.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 19, 1890.

General—In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Narragansett Bay Channel between Starve Goat Island and the mainland, provided for in river and harbor act of September 19, 1890, and made by me from time to time, especially in July and August, 1890.

The improvement desired is the dredging of a channel about one-half mile long, 200 feet wide, and 10 feet deep at mean low water, from the wharves of the Pawtuxet to the deep water of Narragansett Bay.

The town of Pawtuxet is about 4 miles south of Providence, on the west shore of Narragansett Bay. Those who ask for this improvement are Providence business men, residing at Pawtuxet and along the shore north of the town, who desire a better means of communication between their homes and offices than is afforded by the street cars. Such a means of communication would be furnished by the river steamers, should this project be carried out.

This improvement can not be regarded as of great benefit to the general commerce of the country, and for this reason, in my opinion, Narragansett Bay Channel between Starve Goat Island and the mainland is not worthy of improvement by the General Government.

Narragansett Bay Channel is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE.
NEW YORK, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

I concur with Major Livermore in considering that Narragansett Bay Channel between Starve Goat Island and the mainland is not worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

PRELIMINARY EXAMINATION OF WATCH HILL COVE, RHODE ISLAND, IN LITTLE NARRAGANSETT BAY.

[Printed in House Ex. Doc. No. 174, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
WASHINGTON, D. C., January 14, 1891.

SIR: I have the honor to submit the accompanying copy of report dated December 19, 1890, from Maj. W. R. Livermore, Corps of Engineers, giving results of preliminary examination of Watch Hill Cove, in Little Narragansett Bay, Rhode Island, made to comply with provisions of the river and harbor act approved September 19, 1890.

Col. H. L. Abbot, Corps of Engineers, division engineer, northeast division, in forwarding this report concurs in the opinion of Major Livermore that this locality is not worthy of improvement by the General Government, and I approve of the views of these officers.

Very respectfully, your obedient servant,

THOMAS LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
NEWPORT, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Watch Hill Cove, in Little Narragansett Bay, provided for in the river and harbor act of September 19, 1890, and made by me on the 5th of November last:

Watch Hill is at the southeast corner of Little Narragansett Bay; and the cove, in which are situated the small wharves belonging to the settlement at Watch Hill, is separated from Block Island Sound by a narrow sand beach.

At Watch Hill is a light-house, a life-saving station, several large hotels, and cottages. The only business is that of a summer watering place, and as such Watch Hill is yearly increasing in importance.

No boats touch at this point except excursion steamers and other light-draft vessels during the summer months.

The improvement desired is the dredging of a channel of sufficient depth to accommodate such vessels as touch at Watch Hill to a point in the southeastern part of the cove; there is now enough water for steamers to land a short distance north of this point.

This improvement is asked for the benefit of steamers running to Watch Hill from Westerly, Stonington, Norwich, and New London, for the accommodation of summer visitors, which can not be regarded as in the interest of general commerce. For this reason, in my opinion, Watch Hill Cove, in Little Narragansett Bay, is not worthy of improvement by the General Government.

Watch Hill Cove is in the collection district of Stonington, which is a port of entry. The revenue collected at Stonington during the last fiscal year was $1,590. The nearest light-house is Watch Hill Light. The nearest fortification s Fort Trumbull, New London, Conn.

Very respectfully your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
NEW YORK, January 8, 1891.

Respectfully forwarded to the Chief of Engineers.

I concur with Major Livermore in considering that Watch Hill Cove, in Little Narragansett Bay, is not worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

PRELIMINARY EXAMINATION OF NEWPORT HARBOR, RHODE ISLAND, SOUTH OF GOAT ISLAND, WITH A VIEW TO THE REMOVAL OF THE SPIT AT THE SOUTH END OF THE ISLAND.

[Printed in House Ex. Doc. No. 180, Fifty-first Congress, second session.]

Engineer Office, U. S. Army,
Newport, R. I., December 19, 1890.

General: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Newport Harbor, south of Goat Island, provided for in river and harbor act of September 19, 1890, and made by me frequently from time to time.

Goat Island lies due west of Newport, in such position that all vessels entering the harbor by the south entrance are compelled to make a detour around the sand spit at the southern end of the island. This bank extends about 800 feet southeasterly from the island, the depth being in some places less than 1 foot at mean low water.

The improvement desired is the removal of this shoal to a depth of 15 feet at mean low water. This improvement would open a portion of the old channel as an anchorage area equal to about three times the area dredged.

Borings made October 4-9 last show this bank to be composed of mud, gravel, and clay.

In my opinion Newport Harbor south of Goat Island is worthy of improvement by the General Government. The expense is estimated as follows:

88,000 cubic yards excavation, at 25 cents per yard	$22,000
Add 10 per cent. for contingencies	2,200
Total	24,200

Newport Harbor is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Lime Rock Light. The nearest fortification is Fort Adams, Newport, R. I. The population of Newport by the State census of 1885 was 19,556.

Very respectfully, your obedient servant,

W. R. Livermore.
Major of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division).

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
NEW YORK, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

I concur with Major Livermore in considering that Newport Harbor below Goat Island, is worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

Eng 1010.37

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT ITS

JANUARY SESSION, 1893.

PROVIDENCE:
E. L. FREEMAN & SON, STATE PRINTERS
1893.

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

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AT ITS

JANUARY SESSION, 1893.

PROVIDENCE:
E. L. FREEMAN & SON, STATE PRINTERS.
1893.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submits its Seventeenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency, the Governor, with the advice and consent of the Senate, re-appointed Henry C. Bradford, of Providence, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

The harbor line between Fox Point and India Point was changed for a distance of about eleven hundred and twenty-two feet, by an Act of the General Assembly passed March 16, so as to give a straight frontage along the property of the Old Colony Railroad Company on India street and a new wharf has been built there for the use of the Norfolk line of steamers.

A harbor line was established from Central or Red Bridge to Bass rock, a distance of about two and eight-tenths miles, along the easterly shore of Seekonk river, by an Act of the General Assembly passed April 19.

A harbor line near the east shore of the Seekonk river, from the Central or Red bridge to near the old Washington bridge, which was also a boundary line between Providence and East Providence, was re-established and definitely described by an Act of the General Assembly passed May 17.

ENCROACHMENT AND DUMPING.

Illegal dumping to the injury of navigation has been prevented in many cases and nearly constant care has been required to this end and for the prevention of unauthorized obstructions.

The city of Providence has been called upon to fulfill its contract with the State to remove from the Seekonk river material equivalent in amount to that forced beyond prescribed limits by filling from the Brook street district placed by the city several years ago near the shore opposite the present foot of Tockwotten street. The city persisted, under the advice of its engineer, and contrary to the advice of the commissioners, in trying the experiment of this filling and the State being protected by a contract, the experiment was allowed. About eighty-seven percentum of the filling put in, and amounting to many thousand cubic yards, either in itself or by displacement went beyond the lines defined in the license.

Much consideration has been given to the Highway bridges and Railway bridges over waterways which offer more or less obstruction to navigation. The bridges across the East passage near Tiverton and those over the Barrington river have been under special discussion.

Obstructions and encroachments by unauthorized constructions in tide waters, and by dumping ashes from steamers, have been checked and prevented in numerous instances.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters as follows :

No. 151. January 27, to the Fall River and Providence Steamboat Company to drive piles abreast of their wharf between Gold street and Planet street in Providence.

No. 152. February 10, to the Olney Granite Company to build a wharf in a cove of Wickford harbor.

No. 153. March 16, to the Old Colony Railroad to construct a wharf along the new harbor line near India street in Providence.

No. 154. April 13, to George B. Boyden to extend his wharf at Bullock's Point landing near Riverside.

No. 155. April 27, to George Gerhard to drive piles south of Bullock's Point landing.

No. 156. May 4, to Day, Sons and Company to drive piles at their wharf on Dyer street in Providence.

No. 157. May 4, to the New York, Providence and Boston Railroad Company to drive piles at the easterly end of Exchange place in Providence.

No. 158. May 11, to Charles Looff to erect a platform south of Bullock's Point landing.

No. 159. June 29, to the Pomroy Coal Company to rebuild a part of the river wall and foundation in front of their wharf north of Elm street in Providence.

No. 160. July 13, to J. A. Daily and Son to drive piles for the Providence Coal Company at their wharf on Dorrance street slip in Providence.

No. 161. July 13, to J. A. Daily and Son to drive piles for the Pomroy Coal Company at their wharf north of Elm street and on pier near Dyer street, in Providence.

No. 162. July 27, to Joseph Olney and Son to repair their wharf and fender and drive piles, near South Water street at the foot of James street, in Providence.

No. 163. September 21, to the City of Providence to replace the old Washington bridge over the Providence river near Exchange Place.

Assent has been given as follows:—

1. February 10, to M. V. Wilcox to build a wharf from his land bordering on Warwick Cove in the town of Warwick.

2. March 9, to H. N. Campbell, Jr., to construct a wharf on the east shore of Warwick Neck in Kent County.

3. March 9, to Elizabeth L. Pearce to construct a wharf on the east shore of Warwick Neck in Kent County.

4. April 5, to Walter Price and Milo M. Clarke to build a wharf in front of their land in Little Narragansett Bay opposite Watch Hill.

5. May 18, to R. W. Comstock to repair wharf in the town of Warwick on Greenwich Bay.

6. June 15, to Edward W. Barstow and Arthur L. Almy to drive piles for a wharf in Seekonk river.

7. August 3, to Elizabeth L. Pearce to drive piles about her stone wharf at Warwick Neck.

8. October 19, to Joseph S. Lewis to build a wharf easterly from Rock Island in the town of Warwick.

9. November 2, to G. H. Coos to drive piles at his wharf in Warren river.

POINT JUDITH POND.

A proposed breachway into Point Judith Pond has been the subject of communication by letter and by person to the Committee of the U. S. House of Representatives on Rivers and Harbors.

WHARVES IN PUBLIC USE.

It seems desirable that further authority be given by the General Assembly to some department of the State Government to inspect wharves and other structures used by the public on excursions or otherwise, and enforce a reasonable security against serious accidents.

DRAW-BRIDGES.

Further regulation of the use of draw-bridges seems called for.

DEPOSITS WHICH MAY OBSTRUCT

Considerably injury might be prevented by further legislation in regard to such deposits of materials above or beyond tide waters as will inevitably, by the operations of nature, be carried forward or washed into navigable waters.

WORK UNDER U. S. ENGINEER.

By the courtesy of Capt William H. Bixby, Corps of Engineers, we have been furnished with an abstract of work done in Rhode Island under his direction during the fiscal year ending June 30, 1892, with brief notes as to subsequent work, which will be found in the Appendix.

Respectfully submitted,

J. HERBERT SHEDD,
HENRY C. BRADFORD,
WM. C. CLARKE,
Harbor Commissioners.

ABSTRACT OF WORK DONE IN RHODE ISLAND UNDER DIRECTION OF CAPTAIN WM. H. BIXBY, CORPS OF ENGINEERS, U. S. ARMY,

During the fiscal year ending June 30th, 1893, with brief notes as to subsequent work.

IMPROVING PAWTUCKET RIVER, R. I.

The approved project of 1883 provides for the excavation, by dredging, of a channel 100 feet wide and 12 feet deep at mean low water, from deep water above Red Bridge to the ledge opposite Grant & Co.'s wharf at Pawtucket; thence, the deepening, by blasting, of the channel, through the ledge to Pawtucket Bridge, to the same depth and 40 feet wide; at a total cost, as estimated in 1883, of $382,500, of which $145,000 was appropriated prior to June 30th, 1892.

A plan of the works may be found on page 608 of the Annual Report of the Chief of Engineers for 1884.

At the adoption of the present project the river had too narrow a channel, and its ruling depth was only 5 feet.

During the last fiscal year ending 30th of June, 1892, 70,213 cubic yards of sand, gravel and bowlders were dredged from the channel. This channel is now 12 feet deep at mean low water, from the deep water near Red Bridge, at the lower end of the work, to Grant & Co.'s wharf in Pawtucket. It is 100 feet wide from its lower end to Bass Rock, 60 feet wide from Bass Rock to Dunnell's wharf, and 100 feet wide from Dunnell's wharf to Gas Company's wharf and thence, 40 feet wide to Grant & Co.'s wharf.

The work then still to be done was to excavate the channel to its full width of 100 feet from Bass Rock to Dunnell's wharf, and from the Gas Company's wharf to Grant & Co.'s wharf and to deepen the channel through the ledge to the same depth with a width of 40 feet.

There was on June 30th, 1892, $222.68 available for the continuance of work; since then $35,000 was appropriated by Act of July 13th, 1892.

Since the end of the fiscal year June 30th, 1892, and up to the end of the calendar year, there was no work done, with the exception of a minor survey.

REMOVING GREEN JACKET SHOAL, PROVIDENCE RIVER, R. I.

The present approved project of 1885 provides for the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines, at a total cost, as estimated in 1885, of $112,346, of which $79,250, had been appropriated prior to June 30th, 1892.

A plan of Green Jacket Shoal may be found on page 599 of the Annual Report of the Chief of Engineers for 1885.

At the adoption of the present project the harbor at Providence was obstructed by this shoal which occupied about 30 acres of the harbor area. The water on the summit of this shoal was about 1 foot deep. About 13¾ acres of the shoal had already been dredged.

During the last fiscal year ending 30th June, 1892, 125,104 cubic yards of mud and shells were removed, increasing the dredged area by about 4.4 acres.

There was on June 30th, 1892, $12.18 available for the continuance of work; since then $10,000 was appropriated by Act of July 13th, 1892.

Since the end of the fiscal year, June 30th, 1892, and up to December 31st, 1892, no work has been done.

IMPROVING PROVIDENCE RIVER AND NARRAGANSETT BAY, R. I.

The present approved project of 1878 as modified in 1882, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay; and for an anchorage basin between Fox and Field's Points of varying dimensions, from 25 feet depth with 300 feet width, to 6 feet depth with 1060 feet width; all at a total cost, estimated in 1882, at $675,000, of which $560,000 had been appropriated prior to June 30th, 1892. This 25 foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to easily lighting them by range lights.

A plan of the work showing the improved channel, may be found on page 622 of the Annual Report of the Chief of Engineers for 1884.

Before the improvement of this river, many shoals obstructed navigation, and at one point of the channel there was a low water depth of only 4.5 feet.

During the last fiscal year ending 30th June, 1892, 87,776 cubic yards of mud were dredged in this river, thus completing the 12-foot and 6-foot anchorage areas on the east side of Fox Point reach and the 20-foot and part of the 18-foot areas in the Sassafras Point reach. There was then still to be excavated the anchorage basin between the head of Sassafras Point reach and Field's Point.

There was on June 30th, 1892, $49.55 available for the continuance of work; since then $50,000 has been appropriated by Act of July 13th, 1892.

Since the end of the fiscal year, June 30th, 1892, and up to December 31st, 1892, no work has been done.

IMPROVING HARBOR AT NEWPORT, R. I.

The approved project of 1880 as modified in 1882, 1883 and 1884 provided for work at a total cost, estimated in 1884 at $132,000, as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it, by dredging Goat Island Spit northward to a line drawn from the dolphin, which marks the spit, to clear the permanent dock at Fort Adams by 100 feet; and by the excavation of a channel 750 feet wide and 15 feet deep at mean low water, around and to the eastward of this dolphin; excavating to 13 feet at mean low water, the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the Spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the Gas Company's wharf; and the construction of jetties on the western shore of Goat Island to arrest the littoral drift of sand and gravel into the southern entrance.

This above project was further extended in 1892 to embrace the removal of the spit at the south end of Goat Island increasing the estimated cost of improvement to $156,200, of this amount $104,500 had been appropriated prior to June 30th, 1892.

A plan of the works may be found on page 604, Part 1, of the Annual Report of the Chief of Engineers for 1885.

At the adoption of the present project the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (main) entrance was obstructed by a bar which stretched out from Goat Island, and the business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

During the last fiscal year ending 30th June, 1892, no work was done in this harbor.

Previously, however, the southern entrance was completed for vessels of 15 feet draft and, of the total anchorage area, (about 90 acres) to be dredged in the harbor, about 66 acres has been already completed.

There was on June 30, 1892, $1.87 available for the continuance of work. Since then $25,000 was appropriated by Act of July 13th, 1892.

Since the close of fiscal year, June 30, 1892, and up to December 31, 1892, no further work has been done in this harbor.

IMPROVING COVE, COASTER'S HARBOR, R. I.

The present approved project of 1889 proposes to dredge the Cove to the necessary depth and to increase the flow of water by larger openings in the Causeway, all at a total cost, estimated in 1889 at $5,500, which amount was appropriated in 1890.

A plan of this work may be found in House Ex. Doc. No. 65, fifty-first Congress, first Session.

At the adoption of the present project the flow of water around the island was checked by the insufficient openings of the Causeway.

During the last fiscal year ending 30th June, 1892, the work of cutting through the causeway and erecting bridges was begun but not completed.

There was on June 30th, 1892, $1,812.44 available for this work.

Since the end of the fiscal year the work of cutting these larger openings in the causeway and erecting bridges has been completed.

HARBOR OF REFUGE AT POINT JUDITH, R. I.

The present approved project of 1889, modified in 1892, provides for a National Harbor of Refuge at Point Judith. It proposes to construct a rough stone breakwater along the course of Squid Ledge and from the southern end of the ledge toward Point Judith, at a total cost, estimated in 1889 at $1,250,000 (of this amount $75,000 has been appropriated up to June 30, 1892)

A plan of the works may be found in House Ex. Doc. No. 66, 51st Congress 1st Session.

This breakwater is intended mainly for the benefit of the coasting trade, plying between New York and Massachusetts, or going to points still further east.

During the last fiscal year ending 30th June, 1892, 8630 tons of rip-rap stone were placed at the outer end of Squid Ledge, at the angle between the two arms of the proposed breakwater, thus extending both arms about 200 feet and up to nearly low water level. A beacon was erected to mark this construction. A further extension of the breakwater is necessary to complete the project.

There was on June 30th, 1892, $614.90 available for the continuance of work; since then $75,000 has been appropriated by Act of July 13th, 1892.

Since the end of the fiscal year, June 30th, 1892, and up to December 31st, 1892, there has been no further work done with the exception of a minor survey.

IMPROVING HARBOR AT BLOCK ISLAND, R. I.

The present approved project of 1884 as modified in 1888 provides for entirely closing a gap in the old breakwater; for constructing an enlarged inner harbor; and for special temporary dredging along the east side of the enlarged harbor; thus completing, at a total cost of $75,000, a Harbor of Refuge on the eastern side of the Island, consisting of an inner harbor or basin for small vessels and an exterior harbor for larger ones. Up to June 30, 1892, $50,000 of this $75,000 had been appropriated.

A plan of the Block Island improvement may be found on pages 612, and 613, Part 1, Annual Report of Chief of Engineers for 1885.

At the adoption of the present project there was no harbor which afforded protection for decked vessels. The only boats used were open ones which could be hauled up on the beach by oxen upon the approach of a storm.

During the last fiscal year ending 30th June, 1892, 2381 tons of stone were placed in the work, making the completed portion of the north sea wall west of the opening into the harbor, 130 feet long; raising 35 feet of it to the level of high water and 270 feet to within one foot of this level. This carried this portion of the breakwater to its junction with the west sea wall, on which about 90 feet of the foundation was laid. The north and west walls of the enlarged inner harbor still remained to be raised and widened. There was on June 30, 1892, $21.99 available for the continuance of work; since then $24,000 has been appropriated by Act of July 13, 1892. With the exception of a minor survey no further work was done from the end of the fiscal year June 30, 1892 up to December 31, 1892.

IMPROVING PAWCATUCK RIVER, R. I.

The present approved project of 1885 contemplates the widening of the channels to 100 feet below the wharves, and an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and upper wharves; also the deepening of the entire channel to 8 feet at mean low water at a total cost, estimated in 1885 at $38,600; the whole of which amount has been appropriated from time to time prior to June 30, 1892.

A plan of the River may be found on page 314 of the Annual Report of the Chief of Engineers for 1879.

At the adoption of the present project the channel was narrow, crooked, and obstructed by numerous shoals, on some of which there was a depth of about 1 1-2 feet at mean low water.

During the last fiscal year ending 30th June, 1892, 25,416 cubic yards were excavated extending the dredged channel with the full width and depth to within one quarter of a mile of the lower wharves of Westerly; with a least width of 60 feet to within one-eighth of a mile; and with a least width of 40 feet to the lower wharves themselves and to about 300 feet above them. An unexpected ledge of rock was uncovered. Its removal required a further item of $3,800, to complete the project. There was on June 30th, 1892, $158.03 available for the continuance of work; since then $3800 has been appropriated by Act of July 13th, 1892.

Since the end of the fiscal year June 30th, 1892, and up to December 31, 1892 no further work has been done.

IMPROVEMENT OF ENTRANCE TO POINT JUDITH POND, R. I.

Since the close of the last fiscal year, June 30th, 1892, Congress appropriated by Act of July 13th, 1892, $7,500 for the improvement of the entrance to Point Judith Pond. No field work has yet been commenced.

EXAMINATIONS AND SURVEYS.

Examinations and surveys of the following places to determine their worthiness for improvement by the general government, have been ordered by Congress during the last calendar year (Act July 13th, 1892):

Pawtuxet Harbor, Providence River, R. I.
Apponaug Harbor, Cowesset Bay, R. I.
Greenwich Harbor, Greenwich Bay, R. I.
Wickford Harbor, Narragansett Bay, R. I.
Inner Harbor at Point Judith Breakwater, R. I.
Breachway into Salt Pond, Block Island, R. I.

These examinations are now in progress.

WRECKS.

During the fiscal year, ending 30th June, 1892, no wrecks were removed within the limits of Rhode Island, under the provisions of the United States laws.

WRECK OF SCHOONER DAVIS BROTHERS, NARRAGANSETT BAY.

Since the end of the last fiscal year, 30th June, 1892, and between then and the end of the calendar year, 31st December, 1892, the wreck of the Schooner Davis Brothers, an obstruction to navigation, was removed from Dutch Island Harbor, Narragansett Bay. This vessel came into Dutch Island Harbor on fire in June, 1891, and was scuttled to prevent her burning up. She was removed by the United States in October, 1892, under provisions of the United States law.

State of Rhode Island and Providence Plantations.

ANNUAL REPORT

OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT THE

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PROVIDENCE:
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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submits its Eighteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, appointed Alfred W. Kenyon, of Richmond, to the Board for a term of three years beginning the first of July.

HARBOR LINE.

Upon petition of D. Goff & Sons and others for a change in the harbor line on the west bank of the river south of the stone bridge in Pawtucket, it was

Resolved, That the petition of D. Goff & Sons and others be granted, and the Commissioners recommend that the harbor lines be changed by the General Assembly in accordance therewith; *provided*, no section of the river within the proposed harbor lines be made less than the section at present existing just below said change, except where the sections within the present harbor lines are less, and that in such case no diminution be made in said sections.

A plan of the proposed lines accompanied the petition. A copy of the petition and a copy of the resolution of the Board were transmitted to the General Assembly.

ENCROACHMENT AND DUMPING.

Continued vigilance has been required, as heretofore, to prevent unauthorized encroachments.

The city of Providence has at last fulfilled its contract to remove from the Seekonk river as much material as was forced beyond the limits prescribed by this Board, by means of the filling deposited near Tockwotton street. This was a case where work was allowed, under persistent petition of the city, against the judgment of the Harbor Commissioners; but the responsibility for the consequences was assumed by the city under a contract, and now the obstruction, or its equivalent, has been removed at a cost to the city of five thousand dollars.

The statute prohibiting building in public tide waters without authority of either the General Assembly or the Harbor Commissioners has now been in force nearly eighteen years, but the knowledge of such a statute is less general than might be supposed. The Commissioners, many times in a year, find occasion to notify persons to desist from such work until a license has been obtained for it. Such notices are also sometimes required in reference to unauthorized dumping.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters as follows:

No. 164. January 25, to the Old Colony Railroad Company to make alterations and repairs to their wharves near India Point in the city of Providence.

No. 165. March 15, to the New York, New Haven and Hartford Railroad Company to drive piles across the Providence river above the Crawford street bridge in Providence, to support a bridge for railroad tracks.

No. 165-2. April 19, to George Gerhard of East Providence to drive piles and widen the walk at Bullock's Point wharf.

No. 166. May 31, to the Narragansett Electric Lighting Company to lay cables of electric wires across Providence river below and near the Point street bridge.

No. 167. June 28, to J. A. Dailey and Son to drive piles at the wharf of Thos. J. Hill on the east side of Providence river between the New York dock and Doe & Little's wharf.

No. 168. June 28, to J. A. Dailey and Son to drive piles at the pier of the Providence Coal Company at the foot of Orange street in Providence.

No. 169. June 28, to the Pomroy Coal Company to drive piles at the wharf on Dyer street, at the foot of Orange and Peck streets, in Providence.

No. 170. June 28, to the Continental Steamboat Company to drive piles at their wharf at No. 136 Dyer street in Providence.

No. 171. September 13, to Thomas J. Hill to drive piles at his wharf on the westerly side of Providence river.

Assent has been given as follows:

1. March 15, to J. M. Browning to build a breakwater at Watch Hill 100 feet long, subject to removal within six months after notice from this Board.

2. March 29, to the Fall River and Providence Steamboat Co. to drive piles to replace broken ones at their wharf in the city of Providence.

3. April 19, to James G. Burns to construct a boat-landing on his property at Narragansett Pier, subject to removal on the order of this Board upon three months notice.

4. July 5, to Richard Thornley to make alterations and improvements upon his wharf, known as Crompton's wharf, in East Greenwich.

5. July 12, to Thomas J. Hill to build a wharf for the Elizabeth Mills in East Greenwich.

6. July 12, to Thomas J. Hill to make alterations and repairs on his wharf in Apponaug, and to build a small wharf at the same place.

7. July 19, to Elisha A. Leach to build a wharf on his land at Warwick Neck.

8. July 26, to J. A. Dailey & Son to drive a pile for temporary use south of the city wharf in Providence.

9. August 2, to the Continental Steamboat Co. to repair their wharf at Bullock's Point.

10. August 30, to Hughes Bros. & Bangs to build a wharf at Hazard's Quarry in North Kingstown.

11. September 13, to Mrs. Joshua Wilbour to build a sea-wall in Bristol Harbor, south of Union street, fronting her estate.

SEACONNET RIVER BRIDGE.

The Board has received through the kindness of Captain Bixby, Corps of Engineers, U. S. A., a copy of his statement of February 8, 1893, as to the obstruction to navigation offered by the old highway bridge over the Seaconnet river, which is now the property of the State. His conclusions and recommendations were not acted upon by the Secretary of War because of the subsequent decision of the Attorney-General that this State bridge did not come under the jurisdiction of the Secretary of War.

The information contained in the statement is, however, valuable, and a full understanding of the subject may lead to action by the General Assembly towards the removal of obstructions at least, whether a new bridge is built or not. A sectional area suited to the free flow of the tide should be obtained without unnecessary delay.

STATE BRIDGE.

STATEMENT BY W. H. BIXBY, CAPTAIN, CORPS OF ENGINEERS, TO ACCOMPANY REPORT ON THE HEARING OF NOVEMBER 5TH AND 17TH, 1891, AS TO THE QUESTION OF CHANGES NEEDED IN THE STATE HIGHWAY BRIDGE OVER THE SEACONNET RIVER, NEAR TIVERTON, R. I.

(The Seaconnet river at this place is obstructed by two bridges—one a highway bridge belonging to the State of Rhode Island, and the other a railroad bridge operated by the Old Colony R. R. The cases of these two bridges are so radically different that a separate statement is submitted for each, to avoid otherwise great confusion and misunderstanding.)

BRIEF SKETCH OF PROCEEDINGS.

By letters of March and April, 1888, three long petitions, representing about 360 persons (one petition being headed by John W. Davis, then Governor of Rhode Island, and followed by many members of the Rhode Island Legislature) were presented to the U. S. Engineer Department, appealing to the United States Government for aid in behalf of the safe and free navigation of the Seaconnet river, and stating that in the opinion of the signers this bridge should be provided with a swing draw having two free openings each of at least 100 feet clear span and at least 25 feet depth. These petitions were duly forwarded to the Secretary of War and are now on file in either the Engineer or War Department office. At that date Congress had merely provided legislation (Section 8, River and Harbor Act of July 5, 1884) to cover such aids to navigation as could be added to existing bridges, and had not provided for any changes in the width and depth of draw openings. Under such circumstances the memorials of March and April, 1888, resulted only in a suggestion of the Engineer Department (1293 B, Eng'r Dept. 1888,) that the owners of the bridge should have their attention invited to the above quoted Section and Act, with a view to the addition of the needed aids to navigation in the shape of certain floating booms.

Later on, the River and Harbor Act of August 11, 1888, Section 9, having authorized the Secretary of War to require bridge owners to—if necessary—*alter* their bridges in such manner that they should no longer be obstructions to navigation, additional memorials were sent to the Secretary of War between July, 1890, and March, 1891, representing over 500 persons (citizens, merchants, property owners, shippers, schooner captains, and Yacht Clubs) and making essentially the same complaints and demands as those of 1888 (7825

Eng'r Dept. 1890; and 1679, 1 to 61, Eng'r Dept. 1890; 1398 War Dept. 1891). By this time, the new River and Harbor Act of September 19, 1890, Sections 4 and 5, had increased the authority of the Secretary of War and had established penalties for non-obedience to his orders. These new memorials, therefore, under provision of this new Act of Congress, and circular letter of October 15, 1889, from the War Department, and G. O. No. 9 of October 22, 1889, from the Engineer Department, were by letter of December 31, 1890, from the Chief of Engineers (7825 Eng'r Dept. 1890; 1398 B, War Dept. 1891) referred to the Engineer office, Newport, R. I., for investigation by Major W. R. Livermore, my predecessor, then in charge. By virtue of these instructions, hearings were held at the Engineer office at Newport, R. I., on February 24, March 12, March 27, and April 11, 1891, as to which, all interested parties were fully notified. At these hearings it was found that this bridge was owned by the State of Rhode Island, but that the cost of its maintenance and repair fell upon the adjacent cities or towns of Newport, Middletown, Portsmouth, Tiverton and Little Compton; and all these parties, as well as all persons interested in the river navigation, were given full opportunity to present their views. These hearings were reported to the War Department by letters of Major Livermore of the 13th and 22d of June, 1891 (1679, 62 and 71, Eng'r Dept. 1891; 1398 B, 12 and 21, War Dept. 1891) and of the Chief of Engineers of August 3, 1891 (1679, 77, Eng'r Dept. 1891; 1398 B, War Dept. 1891), in which it was recommended that the State of Rhode Island be required to provide its bridge before January 1, 1893, with a draw having an opening of 100 feet in the clear. There appearing some slight doubt on the part of the Judge Advocate General's office (1679, 78, Eng'r Dept. 1891; 1398 B, 27, War Dept. 1891) as to whether the bridge owners had received the full notice required by law, a *further* hearing was ordered by the War Department, September 16, 1891, and of the Engineer Department September 21, 1891 (by indorsement on papers last indicated), the hearing to be held in accord with the instructions of circular letter of September 16, 1891, from the War Department and G. O. No. 6 of September 19, 1891, from the Engineer Department. Under these new instructions, hearings were held at the Engineer office, Newport, R. I., on the 5th and 17th of November, 1891, and at the State House, Newport, R. I., on the 17th of November, 1891; as to which the State of Rhode Island was notified in due form through its Governor; and at which the State, through its Attorney General and a special commission appointed by the Governor, and all other parties or persons interested in the bridge or the river navigation, were given full opportunity to present their views. The result of these hearings are reported herewith, accompanied by copies of the minutes of all previous hearings and by all written documents submitted at these hearings or thought pertinent thereto; and accompanied also with an opinion that the State of Rhode Island has now, without doubt, received all the notice required by law, and with a recommendation that the State of Rhode Island be requested by the United States to take such action as shall secure to navigation through this bridge a free passage way of at least 100 feet clear width, so constructed that it may be later dredged to 25 feet depth at low water without endangering the adjacent piers or abutments; this to be done as soon as possible, and not later than the 1st of January, 1895.

HISTORY OF THE RIVER AND STATE BRIDGE.

The Seaconnet river is an arm of the sea between the island of Rhode Island and the main land, in the vicinity of the towns of Little Compton and Tiverton, extending from the ocean to Narragansett Bay around the head of the island of Rhode Island, and making naturally a deep and specially safe water communication around that island from the ocean to Narragansett Bay and the inland cities of Providence, Fall River, Taunton, and the intermediate towns of the States of Rhode Island and Massachusetts. It is practically an eastern arm of Narragansett Bay. The entrance from the ocean is unobstructed; and a clear, broad and nearly straight channel, running nearly north and south, and of at least 800 feet width and 23 feet depth extends throughout its entire length, the river itself for a distance of about 11 miles at its lower (southern) end having a width of about 1.25 miles and a depth of up to 55 feet, and for a distance of about 1.5 miles at its upper end having a width of about a sixth of a mile and a depth of up to 60 feet; thus offering naturally a direct and deep outlet to the ocean, for the waters of Taunton river and the northeastern portion of Narragansett Bay. The only obstructions to its free navigation are the State highway bridge and the Old Colony Railroad bridge, both at its upper (northern) end, near Tiverton. (See Map 1679, 70, Eng'r Dept. 1891; 1398 B, 20, War Dept. 1891; and Report of the Rhode Island State Commission of 1892, G 1 herewith.)

The State bridge was originally private property, built by a corporation in 1794, under authority of the General Assembly of the State of Rhode Island, and was operated as a toll bridge until 1869, when, being seriously damaged by wave action during a heavy storm, it was by its then owners (the Howland's Ferry Bridge Co.) conveyed to the State of Rhode Island, whose property it has since been. The repairs of 1870-71 were made by the State, the subsequent maintenance and repair were by the State Statutes (Sections 6-7, Chap. 68, page 180, Rhode Island Statutes of 1882, see A5 herewith) imposed upon the adjacent towns of Little Compton, Tiverton, Portsmouth, Middletown and Newport; while the jurisdiction of the adjacent waters was reserved to the State itself (Sections 20-19, Chap. 100, pages 272-271, Rhode Island Statutes of 1882, see A5 herewith). The bridge is really a stone embankment or causeway extending completely across and damming the Seaconnet river, with the exception of one opening of about 29 feet width and a few inches depth of water at low tide, covered by a short section of permanent wooden bridge, and a second opening of about 35 feet clear width and about 9 feet depth of water at low tide, covered by a rolling draw-bridge. The river channel just above and below the bridge has about a quarter of a mile width with 18 feet depth, and has about a sixth of a mile width with from 30 feet to 50 feet depth. (See Report of Rhode Island State Commissioners of 1892, above quoted; and U. S. Coast Survey Chart, No. 353; and Map 1679, 70, Eng'r Dept. 1891, 1398 B, 20, War Dept. 1891.)

At my last visit to the bridge, the abutments of the draw-span had the appearance of being to some extent undermined, a result to be naturally expected sooner or later from such considerable differences in head of water on the two sides of the bridge, and from such rapid currents through the draw opening, as are caused by the small size of the existing opening. It is very probable that some such condition of the abutments will soon force upon the adjacent towns a considerable expense for immediately necessary repairs, greater than they will care to pay for, and under such circumstances the towns may prefer to give up the bridges and go back to a ferry, unless the State will bear a portion of the cost of the probable repairs.

HYDRAULIC AND ENGINEERING CONSIDERATIONS.

At the time of the original construction (about 1794) of the State bridge, and up to the date of the construction (about 1860) of the Railroad bridge, the State bridge did not offer any special obstruction to the navigation of its time. By reference to the U. S. Coast Survey tide tables, it will be seen that the difference of times between high tide in the Seaconnet river below the bridge, and in Narragansett Bay just above the bridge, is only about 10 minutes; and the corresponding interval at low tides is only about 15 minutes; so that all day long, excepting at times of special winds, the heights of water on the two sides of the bridge were approximately equal, or at most but very slightly different. The flow of water through the bridge opening, as caused by the tide, was therefore comparatively slight. A heavy northerly or southerly wind might, of course, bank up the water temporarily on one or the other side, and thus cause a considerable difference of head of water, and a consequent considerable current through the draw opening; but such effect would be but temporary and would mainly disappear soon after the temporary blow was completely over. At the worst, there would always be a time, once every change of tide, that is, once every six or eight hours, when the water would stand at equal height on both sides of the bridge, when the current would therefore disappear, and when the vessels could consequently pass through the draw without difficulty. Moreover, the vessels of that epoch being far smaller than to-day, their passage through the narrow draw was far safer than otherwise. But by the construction of the Railroad bridge the conditions were materially changed.

A reference to the Coast Survey Map (1679, 70, Eng'r Dept. 1891; 1398 B, 20, War Dept. 1891) will show at a glance that the second bridge converted the intermediate waterway (with its connecting "Cove") into an enclosed pond of over half a square mile in area, all of which to a height or depth of about 3 feet (the rise and fall of the tide) must be filled twice a day (every tide) and emptied twice a day, through the three small openings (only about 100 feet combined total length) of the two bridges. The natural result, as may be verified by any one, at either draw, any day, has been that during the greater part of each day, these draw openings resemble mill races through which a vessel can pass with difficulty, and rarely without danger. Bearing this point in mind, there is nothing surprising in the statements of complainants that sailing vessels have been carried by the tide across the abutments and wrecked thereon, or that steamboats have sometimes tried six or seven times without success to get through and failed, and have had to wait two or more hours before the current slackened enough to let them through. Such conditions as these make it imperative that draws should be at least twice as wide as the outside width and much deeper than the draft of the vessels using them. (See also 1679, 65, Eng'r Dept. 1891; 1398 B, 15, War Dept. 1891.) Further the bottom of the draw opening being of rock and forming a narrow sill across the channel between portions of much greater depth, the depth should be from 3 to 5 feet greater than if this bottom were extensive, level and sandy, to make allowances for occasional excessive plunging or "scend" of the boats and for the dangerous character of the bottom. Moreover, as the State bridge faces a long southerly reach of water and is exposed to southerly winds from the ocean, a vessel approaching the draw from the ocean side needs far more margin of width for safety than if in a quiet inland river. Under these circumstances, I have not the slightest hesitation in stating my professional opinion that a single draw of 100 feet width and 25 feet depth at low tide is the smallest draw consistent with safety for vessels attempting to pass up the Seaconnet River and through the State Bridge under ordinary conditions of wind and tide at the present date.

As regards the difficulties of construction of such a draw of 100 feet clear width and 25 feet depth at low tide, I can see no special trouble for engineers of the present day. The existing foundation of the original (and present) causeway should make an excellent foundation for the new piers and abutments. The existing travel is so slight (comparatively speaking) that it might be easily accommodated by a temporary ferry to be established on the northern side and under the protection of the existing causeway, where it could be operated with comparative ease, safety and economy during almost the entire year. In my opinion an entire year should be allowed for the construction of this new draw, in addition to another year for the necessary preliminary legislative action of the State of Rhode Island. Such a draw may cost from $50,000 up to $150,000 according to its quality and other circumstances.

ARGUMENTS, ETC., IN FAVOR OF LARGER DRAWS.

With only one exception (that of the so-called Business Men's Association of Newport, R. I.) all persons concerned, on both sides of the question, are unanimous in asking for the widening of draw opening of this bridge.

PETITIONS.

The following is the list of the principal petitioners:

March, 1888. D. T. Church and about 90 others of Tiverton and Providence. (See A3 herewith.) (Tiverton being one of the four towns responsible for the repair of the bridge).

March 24, 1888. John W. Davis (then Governor of Rhode Island) and about 100 others of Providence and other places (including many members of the Rhode Island Legislature). (See A3 herewith.)

April, 1888. Town Council and about 170 others of Little Compton, R. I. (See A3 herewith.) (Little Compton being one of the four towns responsible for the repair of the bridge.)

The above (about 360 in number) unite in asking for two draw openings each 100 feet wide and 25 feet deep.

July 23, 1890. D. T. Church and about 70 other citizens of Tiverton and Portsmouth. About 190 Masters, Pilots and crew of boats using Seaconnet River. The Commodore and about 50 members of Fall River Yacht Club. The Commodore and about 60 members of Rhode Island Yacht Club. (See 7825, Eng'r Dept. 1890; 1398, B, 26, War Dept. 1891.)

The above (about 370 in number) unite in saying that steamers, sloops and schooners have been seriously damaged, and men drowned, on account of this bridge draw; and that it takes from five to six hours to get through one bridge and from ten to twelve hours to get through both bridges, and that this bridge is an obstruction to navigation and danger to life.

March 14, 1891. Julius A. Petty, Capt. of Steamer "Queen City," formerly Schooner Captain; states his personal knowledge of loss of life, damage to boats, and loss of time, caused by this bridge. (See 1679, 4, Eng'r Dept. 1891; 1398, 5, War Dept. 1891.)

March, April and May, 1891. 62 Captains, Masters, Pilots, of steamers and schooners, by circular letter, claim that on account of the obstructions of these bridges, they are forced to go around another way, thereby losing up to 14.5 miles in distance whenever sailing from Narragansett Bay to the East or returning. (See 1679, 8 to 61, Eng'r Dept. 1891 and 1614, 1 to 12, Eng'r Dept. 1892; 1398, B, 1 to 11, War Dept. 1891; 1398, 6 to 48, War Dept. 1891; and 1640, 1 to 8, War Dept. 1892.)

February 24 and April 11, 1891. Committee of Complainants; ask for two draw openings, each 100 feet wide by 25 feet draft. (See 1679, 63-64, Eng'r Dept. 1891; 1398, B, 13-14, War Dept. 1891.)

March 23, 1891. William Reed, Jr., and about 100 others, claiming to represent $1,000,000 of capital invested in shipping and real estate affected by the bridge, ask for greater depth and 100 feet width of draws. (See 1679, 73, Eng'r Dept. 1891; 1398, B, 23, War Dept. 1891.)

STATEMENTS AT HEARING AND SINCE.

Extent of river travel.

Present travel. Of course the present travel is not as great as it would be if there were no obstructions. One regular steamer and occasional excursion steamers run during the summer from Providence and other parts of Narragansett Bay through the bridge to the mouth of the Seaconnet River, and this travel is stated at over 17,000 passengers in a single season (See D herewith.)

Schooners and sailboats use this route a little, but as little as possible at present on account of its difficulties, delays and danger.

The combined travel is still enough to be very evident; and enough so that one insurance company alone (See A herewith) claims to carry $200,000 insurance on vessels and cargoes passing through the bridges.

Probable future travel. As stated under the heading of "History of Bridge," the Seaconnet River was and is naturally one of the outlets of Narragansett Bay, and is naturally by far the easiest and shortest route for vessels going from the Taunton River and upper Narragansett Bay to Nantucket Sound and the East. The saving in distance (measured on Coast Survey charts) is at least three miles in case of vessels coming from or going to Providence, four miles in case of Warren, six miles in case of Bristol, and twelve miles in case of Coles River, Fall River, Somerset, Dighton and Taunton, and fourteen miles in case of Tiverton; all of these places being important shipping points. The Taunton River alone has a commerce of at least 400,000 tons or $6,000,000 per annum (See page 616 Annual Report, Chief of Engineers, for 1892). Fall River also has a very large commerce by schooners as well as by steamer. At Tiverton is the very large fishing station of the Church Brothers, so large as to use elevators capable of loading 1,000 barrels of fish per hour (see page 3, D, herewith), that use eight fishing steamers of 60 to 160 feet length, from 8 to 15 feet draft, and from 16 to 45 feet width over all (see page 5, D, herewith), and a large part of whose work is done eastward of the Seaconnet River. The possible loss per season to them alone is shown by the computation that 50 round trips for each of eight steamers at 14 miles extra route each way, makes nearly 12,000 extra miles, costing from, say $2,000 to $12,000, according to circumstances. They claim for themselves during 1888, 1889 and 1890 an extra distance thus traveled by their steamers of 20,000 miles, and their total annual loss by extra travel and by time taken from actual work on the fishing ground, as $30,000 (see A4 herewith).

Over 60 boat captains and pilots have already made individual statements (see references under head of "Petitions") that they are forced about 14 miles out of their route every trip to this vicinity.

The Fall River Yacht Club (through Mr. Burdick) and the Rhode Island Yacht Club (through Mr. Janes), representing 125 yachts, and some of from 9 to 12 feet draft, claim that the present bridges obstruct their use of the river and oblige them to go around instead of through this river, that a yacht's loss of time often carries with it a financial loss, that such loss has already been recognized legally, and that therefore the yacht clubs, as a sort of secondary commerce, are entitled to some considerations in matters of river travel (see D herewith, and specially 1679, 69, Eng'r Dept. 1891; 1398, B, 19, War Dept. 1891).

It is not merely the extra distance in miles of travel that causes the protest of boat captains against being obliged to go around Newport Island instead of through the Seaconnet River; but it is more especially the fact that the shorter route often avoids head winds, cross tides, the dangerous Brenton reefs (at S. W. of Island), and exposure to the worst seas of this part of the coast. On this account, the short cut, via Seaconnet River, would save not merely 14 miles of travel, but often a whole day's delay of waiting for favorable winds and tides, or of fighting against adverse ones. This may readily be seen by an inspection of the Coast Survey Charts. Certainly, the Seaconnet River route would be considerably used by schooners and small boats, both of commerce and pleasure, if there were an easy passage for them through the bridges.

Damage already caused. Accidents and delays to boats have been referred to at all hearings and denied by no one. Amongst those so reported the following are prominent: The steamer "Queen City," (see page 2 of D herewith; and also 1679, 75, Eng'r Dept. 1891; 1398, B, 25, War Dept. 1891) with many passengers on board, has several times struck in going through the draw, causing considerable damage and delay. At least one schooner has lost her bowsprit by striking the bridge (see page 2 of D herewith). Not long ago one man was drowned in the draw through the capsizing of his boat by the swift current (see 1679, 4, Eng'r Dept. 1891; 1398, 5, War Dept. 1891).

Admissions by the bridge owners and those who are charged with its repair. As stated under the head of "History" this bridge is owned by the State of Rhode Island, its care and repair falling, however, by State laws upon the five adjacent towns and cities.

Little Compton, through its town council, at several hearings and by special letter, asks either for the widening or the removal of the bridge by the State or United States. (See page 2 of enclosure A; page 49 of F; and also F 3, herewith).

Tiverton, through its town council, at several hearings and by special letter, asks for a draw of at least 100 feet clear width and at least 20 feet depth. (See page 2 of A; E, 6; and page 50 of F, herewith.)

Portsmouth, through a representative from its town council (see page 2 of A herewith) agrees with Newport that there is no question of the necessity for alteration of the bridge.

Middletown, through a representative from its town council, (see page 2 of A herewith) agrees with Newport that there is no question of the necessity for alterations of the bridge.

Newport, through its Mayor, states that there is no question of the necessity for alteration of the bridges (see page 1 of A herewith), and that property and life have been imperilled (page 45 of F herewith).

The State of Rhode Island, through a representative of its Bridge Commission, states that commerce and life are endangered (see page 3 of C herewith); and later the Bridge Commissioners as a body in their special report to the General Assembly of Rhode Island (see pages 5 and 7 of G 1 herewith; also

1679, 67, Eng'r Dept. 1891; 1398, B, 17, War Dept. 1891), state that "it is a notorious fact that this bridge is a serious * * * obstruction to * * * navigation * * * and an injury to the commercial and maritime interests of the people * * * and is a source of danger to life and property * * and practically closes the Seaconnet River to navigation."

At none of the hearings has any one attempted to deny or disprove any of the statements of the complainants as to the actual damages or delays caused to steamers and schooners by this bridge.

ARGUMENTS, ETC., AGAINST ANY CHANGES.

The only protests against the proposed changes are based upon the cost of such change.

The adjacent towns are unanimous in stating that in their opinion the cost of the change ought to fall upon the State of Rhode Island if upon anybody in the State (see pages 1 and 2 of A; page 4 of C, herewith).

The town of Little Compton (page 49 of F, and F 3 herewith) would be willing to see the bridge entirely removed if necessary.

The only strong protest against any change is that of the Business Men's Association of Newport, who submit resolutions (page 88 of F herewith; also 1679, 83, Eng'r Dept. 1891; 1398, B, 31, War Dept. 1891) protesting against any changes on account of its cost, their representative later stating (page 91 of F herewith) that he is much of the opinion of Little Compton that the bridge is of not much account anyway, and certainly not worth $40,000 to rebuild. The value of this protest is much diminished from the fact that this Association is merely a social club, (not a board of trade nor business organization) is not the only club of business men in the city, has no data on which to base any definite statistics of commerce (see F 7 herewith) and that its resolutions were passed by a vote of only 16 against 10 (2 being guests) at a meeting where about one hundred were said to be present, from an association numbering over 160 members (see pages 86, 87 and 57 of F herewith).

The State Commission claim that the State of Rhode Island, as a State, is not amenable to the existing law, and is consequently under no legal obligations in the matter (see pages 4 and 6 of G 1 herewith). At the same time, however, in their special report to the State Assembly in 1892, they admitted the injustice to commerce, and recommended to the State that the latter co-operate with the United States to abate the existing nuisance and danger (see page 8 of 61 herewith).

The Attorney General of the State of Rhode Island in his address at the final hearing (see pages 3-9 of F herewith) makes this plea on non-jurisdiction a little more specific and more detailed, stating his opinion as that not only of himself as the law officer of the State, but also that of the Governor as its Chief Executive; and he especially claims that as to whatever ought to be done at this bridge, its final determination and execution should be left to the State to be done by "the method of comity, conference and deliberation with the State by the General Government through the proper channels." (See page 8 of F herewith.)

The claim of the State of Rhode Island, as made by its Attorney General, that the *United States has no jurisdiction over a state bridge* within the limits of that state (see page 5 of F), seems to me a little doubtful in view of the fact (see Coast Survey maps, and also the statement [page 8 of G 1 herewith] of the Rhode Island State Commission as to the interstate character of the river and bridge) that the Seaconnet River is beyond doubt one of the "navigable waters of the United States in contradistinction to those of an individual State" according to the definition of the United States Supreme Court (see Treasury decisions, 1613 in 1873, and 4376 in 1880, page 150, U. S. Navigation Laws of 1886); being one that "forms in its ordinary condition, by itself or by uniting with other water a continued highway over which commerce is or may be carried on with other States or foreign countries in the customary modes in which such commerce is conducted by water;" and in view also of the long standing opinion of the Attorney General of October, 1853 (see page 151, U. S. Navigation Laws, 1886) that "obstructions to navigation in the navigable waters of the United States, whether by States or individuals, constitute acts of purpresture, and there is remedy in such cases by ex-officio information in the name of the Attorney General of the United States."

In like manner, the claim of the State of Rhode Island, as made by its Attorney General, that this River and Harbor *Act* of September 19, 1890, *does not touch* in any way *the State* of Rhode Island (see page 5 of F), also seems to me a little doubtful in view of the fact that Section 4 of this Act, in specifying the bridges upon whose constructions the Secretary of War must pass judgment ("have reason to believe"), makes use of the words "any railroad or other bridge" without at this point making any limitations whatever; the limitation later made as to ownership being only in connection with the question of the orders to be later issued by the Secretary of War.

In other words, it seems to me, under existing law, that it is plainly the duty of the Secretary of War to investigate the question of the obstruction offered by this bridge; that, if finding the obstruction an unreasonable one, it is further plainly his duty to at least report the amount of the obstructions to the State as the bridge owner; that the State is then plainly responsible for such obstruction and is under legal obligations to remove the same; and that the only point then unsettled is whether the State will shirk its responsibilities merely because there may be some doubts as to its legal liability to criminal prosecution for failure to live up to its just responsibilities and obligations.

The claim of the State Commissioners (see pages 4 and 6 of G 1 herewith) would in like manner seem to me to be subject to similar criticism.

POSITION OF THE BRIDGE OWNERS AT PRESENT.

Acting upon the recommendations of the State Commission of 1891, the General Assembly of Rhode Island shortly afterward (May 20, 1892) authorized the Governor to appoint a new and special commission, (one of whom should be an expert civil engineer) with power to represent the State in any conference upon this matter, and to report to the next Assembly the obligations of the State in relation to the Stone Bridge and to the interests of the Seaconnet River navigation (see G 2 herewith). This commission has not yet made its report; but will probably do so before July of 1893. Meanwhile, of course, no modifications of the bridge have actually been either commenced or decided upon.

REMEDIES SUGGESTED.

Unless the construction of a new draw be assisted or entirely done by the State of Rhode Island or the United States, it is probable that the adjacent towns will abandon the bridge sooner than repair or rebuild it. Suggestions have been made that the present bridge be replaced either by a ferry or by a new bridge along side of or on top of the railroad bridge (about one mile distant). Under such circumstances, it would seem that the United States ought to limit its requests merely to the securing of the necessary opening without (as prescribed by the terms of the original notice) requiring the construction of a draw in addition.

The location of this bridge close to the Massachusetts State line (only four miles therefrom) makes this bridge of almost as much value and use to the large city of Fall River, Mass., and to the other adjacent towns of Massachusetts, as it is to Newport, R. I., and to the other adjacent towns of Rhode Island. In the same way, as the Seaconnet River lies only about four miles west of the Massachusetts State line, its navigation is of almost as much value to Massachusetts as to Rhode Island, a large part of the inward bound navigation going to the Taunton River (Mass.) towns, and a large part of its outward bound navigation going to Nantucket (Mass.) Sound and to other Massachusetts waters; so that there appears some considerable ground for the claim of the Rhode Island State Commissioners (see page 8 of G 1 herewith) that some portion of the work should be done by the General Government.

CONCLUSIONS AND RECOMMENDATIONS.

After a study of all the past correspondence and records of hearings upon this bridge question, and after a personal inspection of the locality at several different times, I am of the opinion that the travel over this bridge is of minor importance in comparison with the present and probable future travel through it, that the present bridge is an unreasonable obstruction to navigation on account of its insufficient width of span and depth of water, and that it ought to be provided with at least one draw span of at least 100 feet clear width and 25 feet depth at low water.

Under all the circumstances of locality, both of bridge and waterway, it seems to me that the bridge and waterway have each so much of an interstate character that it would be perfectly just and proper that at least the deepening of the draw opening should be left to future appropriations by the United States under the provisions of the River and Harbor Appropriations Act, and that the State of Rhode Island should not be required at the most to do more than provide for the increased width of waterway. Moreover, the notice served upon the State, preliminary to the last hearing, did not specify any particular depth in the draw opening.

Also as the State of Rhode Island is dependent upon its own legislative action before it can proceed to execute work, and as the Legislature (its General Assembly) meets only annually, in my opinion it should be allowed at least a year in which to decide upon and formulate its action, in addition to a second year necessary for the actual construction of a new bridge; that is, if the latter construction be adopted as its solution of the engineering problem therein involved.

And further, as there may be a doubt as to whether a State is legally covered by the phraseology of the past River and Harbor legislation as to bridge obstructions in its entirety; or as to whether in this case the law, if valid, can be enforced, practically or advantageously; and especially since the State of Rhode Island admits the existing injustice to navigation and is already taking steps towards its remedy; I would respectfully suggest that the matter for the present be limited to a mere request from the United States to the State of Rhode Island, leaving all questions of law for settlement at some future date.

I have therefore in this case of the State highway bridge over the Seaconnet River, near Tiverton, R. I., to recommend (in default of knowledge of any other more proper method) that the Secretary of War request the Governor of the State of Rhode Island to take such action, if possible, as shall result in the adoption by the State of Rhode Island of such legislation as may be necessary to secure to navigation through this State bridge before the 1st of January, 1895, a free passageway of at least 100 feet clear width, this passageway to be so constructed that it may later be dredged to 25 feet depth at low water without endangering the adjacent piers or abutments; such width and depth being in justice due to the navigation of this river and necessary to render such navigation reasonably free, easy and unobstructed, to the extent required by Section 4, River and Harbor Act of September 19, 1890, for all such bridges as come under United States control.

Respectfully submitted,

WILLIAM H. BIXBY,

Captain, Corps of Engineers, U. S. Army.

WORK UNDER U. S. ENGINEER.

By the courtesy of Captain William H. Bixby, Corps of Engineers, U. S. Army, in charge of river and harbor improvement in this district, we have been furnished with an abstract of work done in the State of Rhode Island, by the United States Government, during the year ending June 30, 1893, with notes as to subsequent work up to December 31, 1893. We present this abstract herewith.

ABSTRACT OF WORK OF RIVER AND HARBOR IMPROVEMENT DONE IN THE STATE OF RHODE ISLAND BY THE UNITED STATES GOVERNMENT UNDER DIRECTION OF CAPT. WM. H. BIXBY, CORPS OF ENGINEERS, U. S. ARMY,

During the fiscal year ending June 30th, 1893, with brief notes as to subsequent work up to December 31st, 1893.

IMPROVING PAWTUCKET RIVER, R. I.

The approved project of 1883 provides for the deepening of the river so as to secure a channel of at least 12 feet depth at mean low water and 100 feet width from deep water at Providence to the ledge opposite Grant & Co.'s wharf at Pawtucket; thence a channel of the same depth and 40 feet width through the ledge to Pawtucket Bridge, all at a total cost, as estimated in 1883, at $382,500, of which $180,000 has been appropriated up to December 31st, 1893, leaving $202,500 still to be appropriated to complete the improvement as projected.

A plan of the works may be found on page 608 of the Annual Report of the Chief of Engineers of 1884, and at page 828 of 1893.

At the adoption of the present project the river had too narrow a channel, and its ruling depth was only 5 feet.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for dredging were entered into.

Since the end of the last fiscal year and up to December 31, 1893, active work of dredging has been carried on under contract, and 33,012 cubic yards of material removed from 9,339 feet length and from 10 to 20 feet width of cutting and to 12 feet depth at low water, completing all contract work. About 381 tons of ledge rock have been removed from the head of the river near Pawtucket, increasing its depth to at least 3.3 feet at low water over the entire ledge and to at least 4 feet over all except a small area of about 25 square feet.

As a result of all work up to December 31st, 1893, the shoalest places have been improved and nearly all of the needed work has been completed, securing a channel of about 12 feet depth at low water, with a ruling width of 100 feet up to the vicinity of the wharves of Pawtucket.

There was on hand December 31st, 1893, a balance of $12 458.40 available for the continuance of work. Work on this river under present appropriations will probably be completed before May, 1894, after which further improvement will await further appropriations.

REMOVING GREEN JACKET SHOAL, PROVIDENCE RIVER, R. I.

The present approved project of 1885 provides for the removal of the entire middle ground shoal in Providence River, opposite the city, to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines of the city; all at a total cost as estimated in 1885 at $112,346' of which $89,250 has been appropriated up to December 31st, 1893, leaving $23,096 still to be appropriated to complete the improvement as projected.

A plan of Green Jacket Shoal may be found on page 599 of the Annual Report of the Chief of Engineers for 1885, and at page 832 of 1893.

At the adoption of the present project the harbor at Providence was obstructed by this shoal, which occupied about 30 acres of the harbor area. The water on the summit of this shoal was about 1 foot deep. About 13 3-4 acres of this shoal has already been dredged.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for dredging were entered into.

Since the end of the last fiscal year dredging has been commenced by the contractor and up to December 31st, 1893, about 34,576 cubic yards of material has been dredged from 860 feet length and from 50 feet width of cutting and to 25 feet depth at low water.

As a result of all work up to December 31st, 1893, 19 acres of this shoal out of the original 30 has been dredged to 25 feet depth at low water, and all the main central part to 16 feet depth everywhere.

There was on December 31st, 1893, a balance of only $899.27 available for the continuance of this work. Work on this improvement under present appropriations will probably be completed before March, 1894, after which further work will await further appropriations.

IMPROVING PROVIDENCE RIVER AND NARRAGANSETT BAY, R. I.

The present approved project of 1878, as modified in 1882, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay; and for an anchorage basin between Fox and Field's Points of varying dimensions, from 25 feet depth with 300 feet width, to 6 feet depth with 1,060 feet width; all at a total cost estimated in 1882 at $675,000, of which $610,000 has been appropriated up to December 31st, 1893, leaving $65,000 still to be appropriated to complete the improvement as projected. This 25 foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to easily lighting them by range lights.

A plan of the work showing the improved channel may be found at page 622 of the Annual Report of the Chief of Engineers for 1884, and at page 830 of 1893.

At the adoption of the present project many shoals obstructed the navigation of this river, the channel was limited to 12 feet depths and the anchorage areas were much too small and shallow for the craft seeking them.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for dredging were entered into. The actual work of dredging was commenced on the 5th of May, 1893, and up to the end of the fiscal year 75,489 yards of mud were excavated from 5,087 feet length and 50 feet width of cutting, very nearly completing the anchorage areas on the west side of the river above Sassafras Point.

Since the end of the last fiscal year and up to December 31st, 1893, dredging has been continued, 227,283 yards of mud having been excavated from 23,495 feet length and 50 to 60 feet width of cutting; completing all the 12 to 20 foot anchorage area on both sides of the Sassafras Point reach, all of the 18 and 20 feet depth anchorage area on both sides of Field's Point reach, and most of the 6 feet depth anchorage areas on the west side of Field's and Sassafras Point reaches. Contract dredging was suspended December 25, 1893.

As a result of all work up to December 31st, 1893, all the 25 feet depth channel, most of the 20 feet depth anchorages, and a large portion of the 18 feet depth anchorages have been dredged, thus nearly finishing the proposed work.

There was on December 31st, 1893, a balance of $4,767.39 available for the continuance of work. Work on this improvement under present appropriations will probably be completed before March, 1894, after which further work will await further appropriations.

IMPROVING HARBOR AT NEWPORT, R. I.

The approved project of 1880, as modified in 1882, 1883, 1884 and 1890, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water, with at least 750 feet width; for the extension of the 13 feet depth and 10 feet depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island; and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor; all at a total cost estimated in 1890 at $156,200, of which $129,500 has been appropriated up to December 31st, 1893, leaving $26,700 still to be appropriated to complete the improvement as projected.

A plan of the works may be found on page 604, part 1, Annual Report of the Chief of Engineers for 1885, and at page 836 of 1893.

At the adoption of the present project this harbor was limited to 12 feet depth at low water and its anchorage area was too small for the craft seeking harborage at this place during the summer, and in storms throughout the year.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for dredging were entered into.

Since the end of the last fiscal year and up to December 31st, 1893, the work of dredging has been carried on at the shoal spit running southward from the south end of Goat Island, 113,937 cubic yards of sand, etc., having been there excavated from 13,145 feet length and 25 feet width of cutting and to 15 feet depth at mean low water.

As a result of all work up to December 31st, 1893, the 15 feet depth channels and the 13 feet depth anchorage basins have been dredged, and one jetty 133 feet long has been built westward from Goat Island, and nearly all the objectionable part of the shoal spit has been removed.

There was on hand December 31st, 1893, a balance of $3,646.50 available for the continuance of the work. Work on this improvement under present appropriations will probably be completed before May, 1894, after which further work will await further appropriations.

HARBOR OF REFUGE AT POINT JUDITH, R. I.

The present approved project of 1889, modified in 1892, provides for a National Harbor of Refuge about one mile square at Point Judith, R. I. It proposes to construct a rough stone breakwater along the course of Squid

Ledge and from the southern end of the ledge toward Point Judith so as to give protection against easterly, southerly and westerly storms, the land itself forming a protection on the north; all at a total cost estimated in 1889 at $1,250,000, of which $250,000 has been appropriated up to December 31st, 1893, leaving $1,000,000 still to be appropriated to complete the improvement as projected.

A plan of the works may be found in House Ex. Doc. No. 66, 51st Congress, 1st Session, and at page 839, Report of Chief of Engineers for 1893.

This breakwater is intended mainly for the benefit of the coasting trade, plying between New York and Massachusetts or going to points still further east.

At the adoption of the present project this point was a specially dangerous place for boats and tows to pass, in even ordinarily bad weather.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for the whole work entered into.

Since the end of the last fiscal year and up to December 31st, 1893, active field work by the contractor has been carried on and 26,505 tons of stone have been placed in the southwest wings of this breakwater.

As a result of all work up to December 31st, 1893, about 500 feet length has been partly built near the middle portion of the breakwater and a light established thereon.

There was on December 31st, 1893, a balance of $17,269.44 available for the continuance of work. This balance will be expended probably before August, 1894, after which further work will await further appropriations.

IMPROVING COVE, COASTERS' HARBOR, R. I.

The present approved project of 1889 proposes to dredge the Cove to the necessary depth and to increase the flow of water by large openings in the causeway, all at a total cost estimated in 1889 at $5,500, which amount was appropriated in 1890.

A plan of this work may be found in House Ex. Doc. No. 65, fifty-first Congress, 1st Session, and at page 835, Report of Chief of Engineers for 1893.

At the adoption of the present project the flow of water around the island was checked by the insufficient openings of the causeway.

During the last fiscal year the work of cutting through the causeway and erecting bridges was completed, the channel was dredged to increase the flow of water and the project finished.

As a result of all work up to December 31st, 1893, the opening in the causeway has been widened and the flow of water around the island much increased.

No further work at this place is now contemplated by this department.

IMPROVING HARBOR AT BLOCK ISLAND, R. I.

The approved project of 1884, as modified in 1888, provides for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) for small vessels, and an exterior harbor for larger ones. The basin was to be about 800 feet square and completely enclosed except at its 100 feet wide entrance. The exterior harbor was already formed by an old breakwater on the east and the adjacent shore on the south and west, but an old gap near the end of this breakwater was to be filled up. The project covers the construction of the stone sea walls of the enlarged inner harbor ($46,000), the repair of the old breakwater ($24,000), and a little dredging ($5,000) along the western side of the old breakwater and also inside the harbor; all at a total cost estimated in 1888 at $75,000, of which $74,000 has been appropriated up to December 31st, 1893, leaving $1,000 still to be appropriated to complete the improvement as projected.

A plan of the works may be found at page 612, Report of the Chief of Engineers for 1885, and further details at page 609 and 613 of 1885, page 506 of 1888 and page 842 of 1893.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

During the last fiscal year preparations were made for the continuance of field work. Minor surveys were made and contracts for the stone work were entered into.

Since the end of the last fiscal year and up to December 31st, 1893, the work of placing stone on the breakwater has been carried on, 6,309 tons having been so placed, thus completing all stone work. Dangerous bowlders have been removed and 4,452 cubic yards of hard sand dredged to 12 feet depth from the shoal at the enlarged entrance to the inner harbor and 960 cubic yards of mud to 10 feet depth from the entrance to the old inner basin. Fender piers have been placed at the entrance to the enlarged inner harbor, thus completing all contract work.

As a result of all work up to December 31st, 1893, the gap in the old breakwater has been filled up so as to make the breakwater of 1,900 feet total length; the north sea wall has been completed and west sea wall also finished, completing all stone work as projected. Fender piers to be placed at the entrance of the enlarged inner harbor are also in place. The shoaled entrances to the basins were dredged.

There was on hand December 31st, 1893, only $4,652.24 available for the continuance of work. Work on this improvement under this appropriation will be completed next summer, after which further work will await further appropriations.

IMPROVING PAWCATUCK RIVER, R. I.

The approved project of 1885, as modified in 1892, provides for the deepening and widening of the river so as to secure a channel of at least 8 feet depth at low water with 100 feet width, from its mouth up to the lower wharves of Westerly, and thence a channel of the same depth with about 40 feet width, up to the upper wharves of the city; all at a total cost estimated in 1891 at $42,400, all of which has been appropriated up to December 31st, 1893.

A plan of the works may be found at page 624 of Report of the Chief of Engineers for 1885, and at page 845 of 1893.

At the adoption of the present project the channel was limited to 5.5 feet depth over 75 feet width below the city and the same depth over 35 feet width opposite the city.

During the last fiscal year preparations were made for the continuance of field work.

Since the end of the last fiscal year and up to December 31st, 1893, actual work of removing obstructing bowlders and rocks has been carried on, clearing off such obstructions down to the general level of the dredged bottom, from about 1,000 feet length of the 100 feet width channel below the city and about 3,000 feet length of the 40 feet channel between the wharves at Westerly.

As a result of all work up to December 31st, 1893, the 8 feet depth channel had been completed to full width from deep water up to within a half mile of the city and to partial width the remaining distance and had been cleared of bowlders.

There was on December 31st, 1893, a balance of $1,679.03 available for the continuance of work. Work on this improvement under present appropriations will be completed probably before May, 1894, after which further work will await further appropriations.

IMPROVEMENT OF ENTRANCE TO POINT JUDITH POND, R. I.

There is at present no approved project for this work, it having been reported as not worthy of improvement in 1873 by General Warren (pages 286-9 Report of Chief of Engineers for 1874, and House Ex. Doc. No. 84 of the 43d Congress, 1st Session); and also as not worthy of improvement in 1888 by Major Livermore (page 642-3 Report for 1889). $7,500 was appropriated for this improvement in 1892; but the unused portion (nearly all) was returned to the U. S. Treasury, November 28, 1893.

At the date of this appropriation the entrance to this Pond was very shallow, (less than 3 feet) crooked, and variable in location.

Up to December 31st, 1893, except inspections of the locality and reports of same, no work had been done on the work of this improvement.

There were on December 31st, 1893, no funds available for the further prosecution of this work.

EXAMINATIONS AND SURVEYS.

In accordance with Act of Congress of July 13th, 1892, preliminary examinations of the following waterways have been made during the last fiscal year, to determine their worthiness of improvement by the General Government. These localities were reported upon as follows:

Pawtuxet Harbor, Providence River, R. I., recommended as not worthy of improvement by the United States.

Apponaug Harbor, Coweset Bay, R. I., recommended as not worthy of improvement at present by the United States.

Greenwich Harbor, Greenwich Bay, R. I., recommended as not worthy of improvement at present by the United States.

Wickford Harbor, Narragansett Bay, R. I., recommended as worthy of moderate improvement by the United States and a survey of this harbor was recommended to determine the character and amount of improvement advisable.

Inner Harbor at Point Judith Breakwater, R. I., recommended as not worthy of improvement at present by the United States.

Breachway into Salt Pond, Block Island, R. I., recommended as not worthy of improvement at present by the United States.

It is hoped that information may be obtained from surveys by the U. S. Engineers, which have been asked for by the Board, to enable a plan to be devised for turning the main ship channel at and below Field's Point slightly to the west so as to avoid the rocky east bank of the present channel, which has heretofore given some trouble to navigation.

Respectfully submitted,

J. HERBERT SHEDD,
HENRY C. BRADFORD,
ALFRED W. KENYON,
} *Harbor Commissioners.*

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State of Rhode Island and Providence Plantations.

ANNUAL REPORT

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OF THE

HARBOR COMMISSIONERS,

MADE TO THE

GENERAL ASSEMBLY

AT THE

JANUARY SESSION, 1895.

PROVIDENCE:
E. L. FREEMAN & SON, PRINTERS TO THE STATE.
1895.

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The Commissioners.

REPORT.

To the Honorable the General Assembly of the State of Rhode Island, etc.:

The Board of Harbor Commissioners respectfully submits its Nineteenth Annual Report.

APPOINTMENT TO THE BOARD.

At the May Session of this General Assembly, His Excellency the Governor, with the advice and consent of the Senate, reappointed J. Herbert Shedd, of Providence, to serve as Harbor Commissioner for a further term of three years from the first of July.

HARBOR LINES.

The establishment of a harbor line along the shore of Bristol for a distance of about two miles is under consideration, as is, also, a harbor line for a length of about one and eight-tenths miles at Narragansett Pier. The protection of the bathing beach at Narragansett Pier from injury by encroachments has occupied much of the time of the Commissioners, including several hearings at the Pier and in Providence.

ENCROACHMENT AND DUMPING.

An increasing amount of care and attention is required to check encroachments and regulate dumping in tide waters.

While the efforts of the Commissioners to check encroachments have been generally successful, there has been one case of unauthorized extension of a wharf in the city of Providence which will be called to the attention of the Attorney General.

BRIDGES.

The highway bridge across the river at Barrington which was authorized by act of the General Assembly passed March 28, 1877, and which required the approval of the Harbor Commission, has been completed during the past year in a satisfactory manner.

The railroad bridge crossing the Seekonk river at India Point, in Providence, is in an unsafe condition, without extra supports, and the Commissioners have assented to the driving of piles in the channel for temporary use, in addition to those which had heretofore been driven. This assent is limited to this and the next year. It is expected that the railroad company will lose no time in reconstruction and that the temporary pile obstructions will be removed much within the limit of time.

Repeated recommendations have been made by this Commission to the General Assembly to enact laws for the better control of draw bridges over navigable waters in this State. An act was passed by Congress in August last providing for the making of rules and regulations by the Secretary of War to govern the opening of drawbridges for the passage of vessels in the waters of the United States, and consultations with the department officers have been had as to the proper rules for this State. An extract from the act of Congress is given in the appendix.

It is anticipated that action will be taken by the Secretary of War and by Congress for the improvement of navigation in Seconnet river, through the railroad bridge and through the stone bridge belonging to the State. A copy of Captain Bixby's statement on this matter is given in the appendix.

LICENSES, ETC.

Licenses have been granted during the year for structures in the public waters as follows:

No. 172. January 22, to the Providence Coal Company to drive piles and rebuild wharf at the foot of Dorrance street, in the city of Providence.

No. 173. January 24, to J. A. Dailey & Son to drive piles at Joseph Olney's coal wharf on South Water street, in the city of Providence.

No. 174. March 14, to John R. Shirley to build a sea wall and fill with earth inside of it, adjoining his estate at Pawtuxet, R. I.

No. 175. March 28, to the Swan Point Cemetery to build a stone sea wall along the harbor line opposite their land on Seekonk river.

No. 176. March 28, to Joseph Olney & Son to drive piles and repair wharf near South Water and James streets, in the city of Providence.

No. 177. June 6, to Conant Thread Company to build a river wall across the water front of their wharf property at Pawtucket.

No. 178. June 6, to James A. Dailey & Son to replace spring piles on the Eben Simmons estate on the west side of Providence river, north of the Point street bridge.

No. 179. June 6, to J. A. Dailey & Son to replace piles and repair the wharf of the Baltimore Steamship Line on India street, in Providence.

No. 180. June 6, to E. S. Fuller and others to build a wharf and mooring on the easterly shore of Narragansett Bay, just north of Pomham Light, opposite property of S. A. Fuller.

No. 181. June 27, to the Fall River and Providence Steamboat Company to replace piles at their wharf in Providence.

No. 182. July 3, to the Fall River and Providence Steamboat Company to drive piles at their wharf in Providence.

No. 183. August 8, to D. L. and L. B. Goff to build a sea wall along the harbor line on their estate on the west side of the river in Pawtucket.

No. 184. August 8, to John Wilde and Charles A. Brown to build a tide water power in Watchemoket Cove, in East Providence.

No. 185. August 29, to the Pomroy Coal Company to drive piles at their wharf on Dyer street, near the foot of Orange and Peck streets, in Providence.

No. 189. September 14, to Continental Steamboat Company to drive piles at their wharf next south of Joseph Olney coal yard, in Providence.

No. 187. September 14, to J. A. Dailey & Son to drive piles at Charles Pay's wharf on South Water street, in Providence.

No. 188. September 14, to J. A. Dailey & Son to replace piles at Charles Olney & Son's coal pocket, in Pawtucket.

No. 189. September 14, to J. A. Dailey & Son to build a sea wall near Tidewater street in Pawtucket, for the Pawtucket Gas Company.

No. 190. October 31, to J. A. Dailey & Son to drive piles at the New York dock, near the foot of South Water street, in Providence.

No. 191. October 31, to R. G. Holmes to build a pile wharf near Allen's avenue, opposite Blackstone street, and next south of the city dock in Providence.

No. 192. November 7, to J. A. Dailey & Son to drive piles and repair wharf owned by the heirs of Thomas J. Hill at the foot of Globe street, on the west side of Providence river.

No. 193. November 7, to J. A. Dailey & Son to drive piles at the wharf of the Pawtucket Gas Company, in Pawtucket.

No. 194. November 14, to J. A. Dailey & Son to replace piles at the wharf of the E. Simmons estate, near the Point street bridge, in Providence.

No. 195. December 7, to Providence Gas Company to replace piles at their wharf near the foot of Public street, in Providence.

No. 196. December 26, to J. A. Dailey & Son to drive piles in the slip at the foot of Dorrance and Ship streets, on the Pearce estate, in Providence.

Assent has been given as follows:

1. February 14, to Robert Broome to fill in waters of Bullock creek opposite land owned by him for the purpose of straightening the shore on his land.

2. March 7, to the Rhode Island Locomotive Works to replace piles at their bridge across the Woonasquatucket river above Acorn street, in Providence.

3. March 14, to the New York, New Haven and Hartford Railroad Company to erect a temporary pile trestle bridge in the Woonasquatucket river, near the Francis street bridge, in Providence.

4. May 16, to the Warren Manufacturing Company to construct a retaining wall and fill behind the same near its mill in Warren.

5. June 6, to James J. Newman to build a wharf in front of his land at Smith's Cove, Rumstick Neck, in the town of Barrington.

6. August 8, to Royal D. Horton and George T. Baker, committee for the town of Barrington, approving the method proposed for the construction of a bridge in said town.

CHANNEL IMPROVEMENT.

The ship channel opposite Field's Point in Providence is very narrow, owing to the projection of a sand spit beyond the harbor line, and the channel bends to the east, crowding upon the rocks, for some distance below Field's Point. The matter of constructing a jetty from Field's Point to Starvegoat Island is under consideration, for the purpose of checking cross currents, the effect of which may be to widen the channel by the washing away of the sand spit and straightening it below by washing away the deposits which continually gather on the west bank, under the present conditions. It is hoped that the United States Government may be induced to undertake this work.

UNITED STATES CONTROL.

The control of local tide waters has, until within a few years, been left by the general government to the states in which they lie. But recently acts have been passed by Congress requiring the Secretary of War to interfere where in his judgment it is necessary, and prevent obstructions and encroachments in public navigable waters. This control overrides the acts of the General Assembly, specifically, in the case of bridges unless approved and authorized by the Secretary of War. It has, therefore, been necessary to apply to the Secretary of War for authority to erect the new Red Bridge which the General Assembly at its last May Session directed the city of Providence to construct.

The new bridge at Barrington also has been subject to objection on the part of the War Department and testimony in regard to the matter is now being prepared.

As to shore waters, including harbor lines and structures not encroaching upon or affecting main ship channels, it is understood to be the policy of the War Department to leave such matters to the control of the local state government as heretofore.

MUNICIPAL DOCKS.

The greatly increased size of modern carrying vessels and the modern method of loading and unloading freight from them economically has seriously lessened the value of wharves built in the old way and not supplied by the best steam worked appliances. Large capital, comparatively, is required for the most economical management, and hence it has been found most advantageous for the municipal government to own and control the wharves and dockage in a place of any considerable commercial importance. Providence has admirable natural advantages for a large shipping business which might be easily developed, and the United States Government has made at great expense improvements in the main channels which were necessary to accommodate the largest sea-going vessels. The question of municipal control of docks is being agitated in Providence and the General Assembly may be called upon to take action in the matter. In the opinion of this Commission the subject is worthy of the most careful and favorable consideration.

COMPENSATION.

The privileges which are granted by the State to private individuals for the reclamation of land from tide waters or the construction of wharves, are sometimes very valuable and the Commissioners respectfully suggest that the General Assembly consider the matter of requiring some compensation where a case warrants it. In Massachusetts a charge per cubic yard of tide water displaced by an improvement is made and collected from the party benefited. In Providence the State sold to the city for a large sum its interest in tide-flowed lands for a certain area, so that precedents for requiring compensation for privileges granted are not wanting.

APPENDIX.

By the courtesy of Captain William H. Bixby, Corps of Engineers, U. S. Army, in charge of river and harbor improvement in this district, we have been furnished with an abstract of work done in the State of Rhode Island by the United States Government, during the year ending June 30, 1894, with notes as to subsequent work up to December 31, 1894. We present this abstract in the appendix.

We also append an extract from the River and Harbor bill of August 17, 1894. Also extracts from act of September 19, 1890, and from act of July 13, 1892.

A full and interesting statement by Captain Bixby in relation to the Old Colony railroad bridge over Seconnet river is appended.

A copy of the act of the General Assembly passed June 13, 1894, in relation to the removal of obstructions to navigation, will be found in the appendix.

Respectfully submitted,

J. HERBERT SHEDD,
H. C. BRADFORD,
ALFRED W. KENYON,
Harbor Commissioners.

APPENDIX.

ABSTRACT OF WORK OF RIVER AND HARBOR IMPROVEMENT DONE IN THE STATE OF RHODE ISLAND BY THE UNITED STATES UNDER DIRECTION OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS, U. S. A., FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH BRIEF NOTES AS TO THE PROGRESS OF WORK UP TO DECEMBER 31, 1894.

(For the approved projects of each work, see the Harbor Commissioners' Report for 1893.)

1. PAWTUCKET RIVER.

Dredging was commenced in August, 1893, and completed in October, 1893, by which 38,975 cubic yards of material were removed from the river channel, completing this channel to 12 feet depth at low water over 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf at Pawtucket. Rock excavation was commenced in September, 1893, and suspended in December, 1893, by which "Seal" rock, projecting above the water at low tide on the edge of the channel and between the channel and the wharves on the west side of the river, was cut down to at least 3.3' at low water; about 406 tons of rock having been removed from 5,000 square feet surface of the ledge. Subsequent to the end of the fiscal year, i. e., between the 1st of July and 31st of December, 1894, contract was entered into for the excavation of rock so as to give a channel 40 feet width and 12 feet depth from Grant & Co.'s wharf up to opposite the City Coal wharf, and then a channel of 40 feet width and 8 feet depth up to opposite the Pawtucket Steamboat Co.'s wharf.

All the work that is to be done under the approved projects and present orders of Congress, is the completion of the channel through the rock ledge to 40 feet width and 12 feet depth at the head of the river, and a little redredging of the existing channel in the lower parts of the river.

2. PROVIDENCE RIVER.

Dredging in progress at the commencement of the fiscal year, i. e., 1st of July, 1893, was continued (except when stopped by ice and severe winter weather) until May 14, 1894, by which 276,474 cubic yards of mud and other material were removed from the river between Fox Point and Field's Point, completing the 6 feet depth anchorage basins to 1060 feet width, the 12 feet depth anchorage basins to 940 feet width, the 18 feet depth basins to 725 feet width, the 20 feet depth basins to 600 feet width, besides redredging a portion of the main channel which had shoaled somewhat since its original dredging, this channel being dredged to 25 feet depth and over 300 feet width. No field work has been done since the end of the fiscal year, i. e., since the 1st of July, 1894.

The only remaining work to be done under the approved projects and orders of Congress is the final redredging of the main channel to 25 feet depth and 300 feet width, after which further work will be stopped unless further orders are received from Congress.

3. GREEN JACKET SHOAL.

Dredging was commenced in November, 1893, and completed in January, 1894, by which 65,272 cubic yards of material were removed from the shoal, leaving 16 feet depth over all the central portions of the shoal, and 20 feet depth in the main channel way. No field work has been done since the end of the fiscal year, i. e., since the 1st of July, 1894.

The work yet to be done under existing projects is the deepening of the entire shoal to 25 feet depth, or so much of it as can be done by the expenditure of $23,000.

4. POINT JUDITH BREAKWATER.

Work was commenced by the contractors in August, 1893, and continued through the fiscal year, by which 92,939 tons of stone were put on the breakwater. Subsequent to end of the fiscal year, i. e., between July 1st, 1894, and December 31st, 1894, 88,055 additional tons of stone have been put into the breakwater, its length now being about 3,000 feet on the bottom and about 1,000 feet at low water level.

Further work toward the completion of the breakwater awaits further appropriation.

5. BLOCK ISLAND BREAKWATER AND HARBOR.

Work on the harbor walls and entrance, in progress at the commencement of the fiscal year (July 1st, 1893), was continued until December 10th, 1893, by which 6,768 tons of stone were put into the harbor walls and 5,412 cubic yards of sand, mud, etc., were removed from the entrance to the inner and outer harbors, leaving 12 feet depth of channel in the outer harbor and 10 feet depth of channel in the inner harbor. The appropriations of the past year provide for a survey and for a project for the further needed improvement of this harbor. No field work has been done since the end of the last fiscal year, i. e., since the 1st of July, 1894.

Further work awaits further appropriations.

6. Pawcatuck River.

The small amount of available funds allowed a little work during the past fiscal year, and in August and September, 1893, 67 tons of bowlders and 59 tons of ledge rock were removed from the main channel opposite the city. The last appropriations provide for a further survey and for a project for further necessary improvements in this river.

7. Newport Harbor.

Dredging in progress at the commencement of the fiscal year, i. e., July 1st, 1893, was continued until February, 1894, by which 151,879 cubic yards of mud, sand and bowlders were removed from Goat Island Spit, and a new pile dolphin built to mark the new end of the shoal. Since the end of the fiscal year, i. e., since the first of July, 1894, about 400 cubic yards more of material have been removed from the main channel opposite the southern end of Goat Island.

The last appropriation bill provided for about $7,000 worth of work upon the removal of Spindle Rock at the entrance to this harbor, which work will be commenced early in 1895.

All that remains to be done under existing approved projects in this harbor is the excavation of a small portion of the 10 feet anchorage basin, or such of the same as can be done for the expenditure of about $27,000, and no further extensions of the existing projects will be made until specially ordered by Congress.

BRIDGES OBSTRUCTING NAVIGATION.

Old Colony R. R. Bridge across the Seconnet River.

The Old Colony R. R. bridge has been for many years a serious obstruction to the navigation of Seconnet River, and has been a serious damage to the coasting trade of Providence, Bristol and Warren, of Rhode Island, as well as to Taunton and Fall River, of Massachusetts. In the memorandum filed with the Secretary of War on behalf of the State of Rhode Island (see page 24 report of the State Bridge Commission to the General Assembly of the State of Rhode Island at its January, 1893 Session), it is stated by Attorney General R. W. Franklin and Mr. Charles Acton Ives on behalf of the State, that this railroad bridge is not constructed in accordance with the act under which it was built, broadly and properly considered, and that by it the navigation of the river is rendered practically impossible.

On the 1st of July, 1893, the Secretary of War issued orders that this bridge should be provided, before the 1st of July, 1894, with a clear draw span of 100 feet width, subject to certain penalties in case of disobedience of this order. Nothing, however, has been done by the railroad company up to the present day, and it is presumed that steps will have to be taken for the enforcement of the consequent penalties through the United States Attorney General's department.

STATE BRIDGE ACROSS THE SECONNET RIVER.

The stone bridge belonging to the State of Rhode Island, and crossing the Seconnet River about a mile south of the railroad bridge, is also a serious obstruction to the navigation of the Seconnet river; and such serious obstruction to navigation has been admitted by the State of Rhode Island, with the result that the State has granted permission to the United States to open a channel through the bridge whenever a similar channel shall have been made through the railroad bridge. The past appropriations for harbor improvements in Rhode Island provide for a survey and estimate of cost of the dredging of such a channel through the State bridge.

BARRINGTON BRIDGES.

The Barrington river, close to its mouth, is crossed by one railroad and one highway bridge, both of which are without movable draws and both of which rest upon causeways which improperly dam up the flow of water in the river, and convert the bridge openings into mill races, such that it is with the greatest difficulty, even at low tide and slack water, that boats even taking down their masts, can get under the bridge to pass up the river. Protests have been made from time to time against continuing the existence of such bridges, but so far without avail. It is believed that these bridges, in their present condition, have never been authorized or their construction approved by the State of Rhode Island. Their continuance is at present a matter still under consideration by the United States war department.

Across the Barrington river, about 2 miles above the railway bridge, a second highway bridge has been recently constructed, cutting off access to a mile or so of good navigable channel and wharfage facilities above the bridge, in spite of the protests of at least one boat owner who had been accustomed to make trips with his boat to points above such bridge. The construction of this bridge has not yet been approved by the Secretary of War, and the question of a draw or a large boating span through this bridge is still under consideration by the war department.

EXTRACT FROM RIVER AND HARBOR BILL (ACT NO. 198 PUBLIC) OF 17 AUGUST, 1894.

SEC. 5. That it shall be the duty of all persons owning, operating and tending the *drawbridges* now built or which may hereafter be built across the navigable rivers and other waters of the United States, to open, or cause to be opened, *the draws of such bridges under such rules and regulations as in the opinion of the Secretary of War* the public interests require to govern the opening of drawbridges for the passage of vessels and other water crafts, and such rules and regulations, when so made and published, shall have the force of law. Every such person who shall willfully fail or refuse to open, or cause to be opened, the draw of any such bridge for the passage of a boat or boats, or who shall unreasonably delay the opening of said draw after reasonable signal shall have been given as provided in such regulations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than two thousand dollars, nor less than one thousand dollars, or by imprisonment (in the case of a natural person) for not exceeding one year, or by both such fine and imprisonment in the discretion of the court. *Provided*, that the proper action to enforce the provisions of this section may be commenced before any commissioner, judge, or court of the United States, and such commissioner, judge or court shall proceed in respect thereto as authorized by law in case of crimes against the United States. *Provided further*, that whenever in the opinion of the *Secretary of War* the public interests require it he may *make rules and regulations to govern the opening of drawbridges* for the passage of vessels and other water crafts; and such rules and regulations, when so made and published, shall have the force of law, and any violation thereof shall be punished as hereinbefore provided.

EXTRACT FROM RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

SEC. 4. That section nine of the river and harbor act of August eleventh, eighteen hundred and eighty-eight, be amended and reenacted so as to read as follows:

That whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed over any of the navigable water-ways of the United States is an unreasonable obstruction to the free navigation of such waters on account of insufficient height, width of span, or otherwise, or where there is difficulty in passing the draw-opening or the draw span of such bridge by rafts, steam boats, or other water-craft, it shall be the duty of the said Secretary, first giving the parties reasonable opportunity to be heard, to give notice to the persons or corporations owning or controlling such bridge so to alter the same as to render navigation through or under it reasonably free, easy and unobstructed; and in giving such notice he shall specify the changes required to be made, and shall prescribe in each case a reasonable time in which to make them. If at the end of such time the alteration has not been made, the Secretary of War shall forthwith notify the United States district attorney for the district in which such bridge is situated, to the end that the criminal proceedings mentioned in the succeeding section may be taken.

SEC. 5. That section ten of the river and harbor act of August eleventh, eighteen hundred and eighty-eight, be amended and reenacted so as to read as follows:

That if the persons, corporations, or associations owning or controlling any railroad or other bridge shall, after receiving notice to that effect as hereinbefore required from the Secretary of War and within the time prescribed by him, willfully fail or refuse to remove the same, or to comply with the lawful order of the Secretary of War in the premises such persons, corporation or association shall be deemed guilty of a misdemeanor and, on conviction thereof, shall be punished by a fine not exceeding five thousand dollars, and every month such persons, corporation, or association shall remain in default in respect to the removal or alteration of such bridge shall be deemed a new offense, and subject the persons, corporation, or association so offending to the penalties above prescribed.

SEC. 6. That it shall not be lawful to cast, throw, empty or unlade, or cause, suffer, or procure to be cast, thrown, emptied, or unladen, either from or out of any ship, vessel, lighter, barge, boat, or other craft, or from the shore, pier, wharf, furnace, manufacturing establishments, or mills of any kind whatever, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, slag, cinders, ashes, refuse, or other waste of any kind, into any port, road, road-stead, harbor, haven, navigable river, or navigable waters of the United States which shall tend to impede or obstruct navigation, or to deposit or place or cause, suffer, or procure to be deposited or placed, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, or other waste in any place or situation on the bank of any navigable waters where the same shall be liable to be washed into such navigable waters, either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed; *Provided*, That nothing herein contained shall extend or be construed to extend to the casting out, unlading, or throwing out of any ship or vessel, lighter, barge, boat, or other craft, any stones, rocks, bricks, lime, or other materials used, or to be used, in or toward the building, repairing, or keeping in repair any quay, pier, wharf, weir, bridge, building, or other work lawfully erected or to be erected on the banks or sides of any port, harbor, haven, channel, or navigable river, or to the casting out, unlading, or depositing of any material excavated for the improvement of navigable waters, into such places and in such manner as may be deemed by the United States officer supervising said improvement most judicious and practicable and for the best interests of such improvements, or to prevent the depositing of any substance above mentioned under a permit from the Secretary of War, which he is hereby authorized to grant, in any place designated by him where navigation will not be obstructed thereby.

SEC. 7. That it shall not be lawful to build any wharf, pier, dolphin, boom, dam, weir, breakwater, bulkhead, jetty, or structure of any kind outside established harbor-lines, or in any navigable waters of the United States where no harbor-lines are or may be established, without the permission of the Secretary of War, in any port, roadstead, haven, harbor, navigable river, or other waters of the United States, in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters, and it shall not be lawful hereafter to commence the construction of any bridge, draw-bridge, bridge piers and abutments, causeway or other works over or in any port, road, roadstead, haven, harbor, navigable river, or navigable waters of the United States, under any act of the legislative assembly of any State, until the location and plan of such bridge or other works have been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of said navigable water of the United States, unless approved and authorized by the Secretary of War; *Provided*, That this section shall not apply to any bridge, bridge-draw, bridge piers and abutments the construction of which has been heretofore duly authorized by law, or be so construed as to authorize the construction of any bridge, draw bridge, bridge piers and abutments, or other works, under an act of the legislature of any State, over or in any stream, port, roadstead, haven or harbor, or other navigable water not wholly within the limits of such State.

SEC. 8. That all wrecks of vessels and other obstructions to the navigation of any port, roadstead, harbor, or navigable river, or other navigable waters of the United States, which may have been permitted by the owners thereof or the parties by whom they were caused to remain to the injury of commerce and navigation for a longer period than two months, shall be subject to be broken up and removed by the Secretary of War, without liability for any damage to the owners of the same.

SEC. 9. That it shall not be lawful for any person or persons to take possession of or make use for any exclusive purpose, or build upon, alter, deface, destroy, injure, obstruct, or in any other manner impair the usefulness of any sea-wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States in whole or in part, for the preservation and improvement of any of its navigable waters, or to prevent floods, or as boundary marks, tide-gauges, surveying-stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works.

SEC. 10. That the creation of any obstruction not affirmatively authorized by law, to the navigable capacity of any waters, in respect of which the United States has jurisdiction, is hereby prohibited. The continuance of any such obstruction, except bridges, piers, docks and wharves, and similar structures erected for business purposes, whether heretofore or hereafter created, shall constitute an offense and each week's continuance of any such obstruction shall be deemed a separate offense. Every person and every corporation which shall be guilty of creating or continuing any such unlawful obstruction in this act mentioned, or who shall violate the provisions of the last four preceding sections of this act, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding five thousand dollars, or by imprisonment (in the case of a natural person) not exceeding one year, or by both such punishments, in the discretion of the court, the creating or continuing of any unlawful obstruction in this act mentioned may be prevented and such obstruction may be caused to be removed by the injunction of any circuit court exercising jurisdiction in any district in which such obstruction may be threatened or may exist; and proper proceedings in equity to this end may be instituted under the direction of the Attorney-General of the United States.

SEC. 11. That it shall be the duty of officers and agents having the supervision, on the part of the United States, of the works in progress for the preservation and improvement of said navigable waters, and, in their absence, of the United States collectors of customs and other revenue officers to enforce the provisions of this act by giving information to the district attorney of the United States for the district in which any violation of any provision of this act shall have been committed: *Provided*, That the provisions of this act shall not apply to Torch Lake, Houghton County, Michigan.

SEC. 12. That section twelve of the river and harbor act of August eleventh, eighteen hundred and eighty-eight, be amended and reenacted so as to read as follows:

Where it is made manifest to the Secretary of War that the establishment of harbor-lines is essential to the preservation and protection of harbors, he may, and is hereby authorized, to cause such lines to be established, beyond which no piers, wharves, bulk-heads or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him; and any person who shall willfully violate the provisions of this section, or any rule or regulation made by the Secretary of War in pursuance of this section, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, at the discretion of the court for each offense.

FROM ACT OF JULY 13, 1892.

SEC. 5. That no money appropriated for the improvement of rivers and harbors in this act or hereafter, shall be expended for dredging inside of harbor-lines duly established.

OLD COLONY RAILROAD BRIDGE.

Statement by W. H. Bixby, Captain, Corps of Engineers, to accompany report on the hearing of November 5th and 17th, 1891, as to the question of changes needed in the Old Colony R. R. bridge over the Seaconnet river, near Tiverton, R. I.

(The Seaconnet river at this place is obstructed by two bridges; one, a highway bridge belonging to the State of Rhode Island, and the other a railroad bridge operated by the Old Colony railroad. The cases of these two bridges are so radically different that a separate statement is submitted for each, to avoid otherwise great confusion and misunderstanding.)

BRIEF SKETCH OF PROCEEDINGS.

By letters of March and April, 1888, three long petitions (see A 3 herewith), representing about 360 persons (one petition being headed by John W. Davis, then Governor of Rhode Island, and followed by many members of the Rhode

Island Legislature) were presented to the U. S. Engineer Department, appealing to the United States Government for aid in behalf of the safe and free navigation of the Seaconnet river, and stating that in the opinion of the signers this bridge should be provided with a swing draw having two free openings each of at least 100 feet clear span and at least 25 feet depth. These petitions were duly forwarded to the Secretary of War and are now on file in either the Engineer or War Department office. At that date Congress had merely provided legislation (Section 8, River and Harbor Act of July 5, 1884) to cover such aids to navigation as could be added to existing bridges, and had not provided for any changes in the width and depth of draw openings. Under such circumstances the memorials of March and April, 1888, resulted only in a decision of the Secretary of War, under date of May 12, 1888, (1293 B, Engr. Dept.—1888) by which the Old Colony R. R. was required to add and maintain on each side of the bridge and also on each side of the draw opening, floating booms of about 5 feet width, 3 feet depth and 200 feet length, as guides or fenders to vessels passing through the draw. These booms have remained in use until the present date (except during the freezing months of winter); but they have been found to be about as troublesome as advantageous to passing vessels.

Later on, the River and Harbor Act of August 11, 1888, Section 9, having authorized the Secretary of War to require bridge owners to, if necessary, alter their bridges in such manner that they should no longer be obstructions to navigation, additional memorials were sent to the Secretary of War between July, 1890, and March, 1891, representing over 500 persons (citizens, merchants, property owners, shippers, schooner captains and Yacht Clubs) and making essentially the same complaints and demands as those of 1888 (7825, Engr. Dept., 1890; and 1679, 1 to 61, Engr. Dept., 1890; 1398, War Dept., 1891). By this time, the new River and Harbor Act of September 19, 1890, Sections 4 and 5, had increased the authority of the Secretary of War and had established penalties for non-obedience to his orders. These new memorials therefore, under provision of this new Act of Congress, and circular letter of October 15, 1889, from the War Department, and G. O. No. 9 of October 22, 1889, from the Engineer Department, were by letter of December 31, 1890, from the Chief of Engineers (7825, Engr. Dept., 1890; 1398, B, War Dept., 1891) referred to the Engineer Office, Newport, R. I., for investigation by Major W. R. Livermore, my predecessor, then in charge. By virtue of these instructions, hearings were held at the Engineer Office at Newport, R. I., on February 24, March 12, March 27 and April 11, 1891, as to which, all the interested parties were fully notified. At these hearings, the Old Colony R. R., as well as all parties interested in the river navigation, were given full opportunity to present their views. These hearings were reported to the War Department by letters of Major Livermore of the 13th and 22d June, 1891, (1679, 62 and 71, Engr. Dept., 1891; 1398, B, 12 and 21, War Dept., 1891,) and of the Chief of Engineers of August 3, 1891, (1679, 77, Engr. Dept., 1891; 1398, B, War Dept., 1891,) in which it was recommended that the Old Colony R. R. be required to provide its bridge before January 1, 1893, with a draw having an opening of 100 feet width in the clear. There appearing some slight doubt on the part of the Judge Advocate General's Office (1679, 78, Engr. Dept., 1891; 1398, B, 27, War Dept., 1891,) as to whether the bridge owners had received the full notice required by law, a *further* hearing was ordered by the War Department, September 16, 1891, and of the Engineer Department, September 21, 1891, (by indorsement on papers last indicated,) the hearing to be held in accord with the instructions of circular letter of September 16, 1891, from the War Department and G. O. No. 6 of September 19, 1891, from the Engineer Department. Under these new instructions, hearings were held at the Engineer Office, Newport, R. I., on November 5 and 17, 1891, and at the State House, Newport, R. I., on November 17, 1891; as to which the Old Colony R. R. was notified in due form through its President; and at which the R. R., through its President and counsel, and all other parties or persons interested in the bridge or the river navigation, were given full opportunity to present their views. The result of these hearings is reported herewith accompanied by copies of the minutes of all previous hearings and by all written documents submitted at these hearings or thought pertinent thereto; and accompanied also with an opinion that the Old Colony R. R. has now without doubt received all the notice required by law, and with a recommendation that the Old Colony R. R. be required to provide its bridge before the 1st of July, 1894, with a draw having an opening of at least 100 feet clear width, and that they be at the same time cautioned that the needs of future navigation will probably soon require this opening to be deepened to 25 feet depth at low water and that the piers and abutments of the draw span ought to be constructed accordingly.

HISTORY OF THE RIVER AND OLD COLONY R. R. BRIDGE.

The Seaconnet River is an arm of the sea between the Island of Rhode Island and the main land in the vicinity of the towns of Little Compton and Tiverton, extending from the ocean to Narragansett Bay around the head of the island of Rhode Island, and making naturally a deep and specially safe water communication around that island from the ocean to Narragansett Bay and the inland cities of Providence, Fall River, Taunton and the intermediate towns of the States of Rhode Island and Massachusetts. It is practically an Eastern arm of Narragansett Bay. The entrance from the ocean is unobstructed; and a clear, broad and nearly straight channel, running nearly north and south, and of at least 300 feet width and 23 feet depth extends throughout its entire length, the river itself for a distance of about 11 miles at its lower (southern) end having a width of about 1.25 miles and a depth of up to 35 feet, and for a distance of about 1.5 miles at its upper end having a width of about a sixth of a mile and a depth of up to 60 feet; thus offering naturally a direct and deep outlet to the ocean, for the waters of Taunton River and the northeastern portion of Narragansett Bay. The only obstructions to its free navigation are the State highway bridge and the Old Colony R. R. bridge, both at its upper (northern) end near Tiverton. (See map 1679, 70, Engr. Dept., 1891; 1398, B, 20, War Dept., 1891; and report of the R. I. State Commission of 1892, G, 1, herewith.) The construction of this Old Colony R. R. bridge, is said to have been originally authorized by Sec. 3, No. 11, Acts of the Rhode Island General Assembly of 1846 in a grant to the Newport and Fall River Railroad Co., extended by Section 5, No. 3, Act of 1862, by which the railroad was required to construct and maintain in their bridge a suitable draw of at least 33 feet clear width (See copy of these Acts, F, 9, herewith, as furnished by the Railroad Company). The date of the actual construction of this bridge is said to have been about 1860. The so-called bridge itself is a causeway, consisting of a solid embankment having a core of sand, gravel and stone, and a facing of heavy stone rip-rap, and extending completely across and damming the Seaconnet River, with the exception of a single draw span opening of about 33 feet clear width and about 10 feet clear depth at low tide. This opening is spanned by a pair of open-built iron girders, each carrying one rail of a single track road, the girders being arranged so as to be swung to one side whenever necessary to allow the passage of boats through the draw opening. The river channel just above and below this bridge, is about a quarter of a mile wide with 18 feet depth, and has about a sixth of a mile width, with from 30 to 50 feet depth (See Report of Rhode Island State Commissioners of 1892, above quoted; and U. S. Coast Survey Chart No. 353; and map 1679, 70, Engr. Dept., 1891; 1398, B, 20, War Dept., 1891).

At my last visit to the bridge, the abutments of the draw-span had the appearance of being to some extent undermined, a result to be naturally expected sooner or later from such considerable difference in head of water on the two sides of the bridge and from such rapid currents through the draw opening, as are caused by the small size of the existing opening.

HYDRAULIC AND ENGINEERING CONSIDERATIONS.

Up to the date (about 1860) of the construction of the railroad bridge across the Seaconnet River, the other bridge (the State bridge) did not offer any special (See p. 82 of F, herewith) obstruction to the navigation of its time. By reference to the U. S. Coast Survey tide tables, it will be seen that the difference of times between high tide in the Seaconnet River below the bridge, and in Narragansett Bay just above the bridge is only about 10 minutes; and the corresponding interval at low tides is only about 15 minutes; so that all day long, excepting at times of special winds, the heights of water on the two sides of the bridge were approximately equal, or at the most but very slightly different. The flow of water through the bridge opening, as caused by the tide, was therefore comparatively slight. A heavy northerly or southerly wind might of course bank up the water temporarily on one or the other side, and then cause a considerable difference of head of water, and a consequent considerable current through the draw opening; but such effect would be but temporary and would mainly disappear soon after the temporary blow was completely over. At the worst, there would always be a time, once every change of tide, that is once every six or eight hours, when the water would stand at equal height on both sides of the bridge, when the current would therefore disappear, and when the vessels could consequently pass through the draw without difficulty. Moreover, the vessels of that epoch being far smaller than to-day, their passage through the narrow draw was far safer than otherwise. But by the construction of the railroad bridge the conditions were materially changed. A reference to the Coast Survey map (1679, 70, Engr. Dept., 1891; 1398, B, 20, War Dept., 1891,) will show at a glance that the second bridge converted the intermediate waterway (with its connecting "Cove") into an enclosed pond of over half a square mile in area, all of which to a height or depth of about 3 feet (the rise and fall of the tide) must be filled twice a day (every tide) and emptied twice a day, through the three small openings (only about 100 feet combined total length) of the two bridges. The natural result, as may be verified by any one, at either draw, any day, has been that during the greater part of each day, these draw openings resemble mill races through which a vessel can pass with difficulty and rarely without danger. Bearing this point in mind, there is nothing surprising in the statements of complainants that sailing vessels have been carried by the tide across the abutments and wrecked thereon, or that steamboats have sometimes tried six or seven times, without success, to get through, and failed, and have had to wait two or more hours before the current slackened enough to let them through. Such conditions as these make it imperative that draws should be at least twice as wide as the outside width, and much deeper than the draft of the vessels using them (see also 1679, 65 Engr. Dept., 1891, 1398, B. 15, War Dept., 1891). Further, the bottom of the draw opening being of rock, and forming a narrow sill across the channel between the portions of much greater depth, the depth should be from three to five feet greater than if this bottom were extensive, level and sandy, to make allowances for occasional excessive plunging, or "scend," of the boats, and for the dangerous character of the bottom.

Moreover, any strong wind banking up the water on one side of the one bridge, will make such a difference in the heads of water at the two bridges, and such a consequent difference in the times of slack water in their draws that a vessel, after waiting several hours to get through the first bridge, may readily find itself obliged to wait several hours more until the next change of tide before being able to pass through the second bridge (see p. 2 of 1679, 69 Engr. Dept., 1891; 1398, B. 19, War Dept., 1891). This trouble may even occur on a perfectly calm and fair day (see p. 1 of 1679, 65 Engr. Dept., 1891; 1398, B. 15, War Dept., 1891). Such possibilities need no proof, but merely assertion; as they are self-evident to an engineer as soon as his attention is called thereto. These adverse conditions, as they exist at present, are almost entirely due to the solid construction of the second bridge (the R. R. bridge); and this result might have been easily predicted by any one who had given the slightest thought to the subject. It is quite natural that the members of the Rhode Island Assembly of 1846 and 1862, not being engineers by profession, should not have considered this question; but it is hardly possible to imagine that these results were not foreseen and fully comprehended by the engineer of the railroad company at the time of construction of the bridge in 1860, railroad companies in New England at that date, as now, being, through the nature of their work, obliged to use the best engineering, as well as legal, talent that money can hire. The Act of 1846 of the Rhode Island Assembly (see Section 3 of the copy herewith) gave the R. R. permission, if it so chose to do, to make a crossing of the river overhead, or upon the side of the existing State Bridge; which method of crossing would have obviated all the subsequent trouble from ponding such a large volume of water, would have much simplified the question of draws and river navigation, and would have strengthened both bridges. Under such circumstances the separate construction of the second bridge by the R. R. makes it responsible for all the bad results that have followed; and, as a matter of equity, in my opinion, it is the owners of the railroad, if any one, that should be obliged, first and most thoroughly, to repair the damage that the railroad causeway has caused to the navigation of this river; and the present R. R. company ought to be prepared to shoulder the disadvantages, along with the advantages, of its predecessor's powers and privileges. In order to completely restore the navigational facilities of this river to its original good condition, as it was before the R. R. causeway was built, this causeway should be cut down to low water level over its entire length, and the upper portion, thus removed, should be replaced by open trestle work, or by long spans resting upon isolated piers. However, a portion of this work, say openings of from 300 to 600 feet total length, will probably be sufficient for the needs of the navigation of the next ten or more years. In my opinion, a movable draw having a *clear opening of 100 feet* and a *depth of 25 feet* of water at low tide, is *certainly* the *smallest single draw consistent with safety* for vessels of the present day attempting to pass up and down the Seaconnet river through this railroad bridge under ordinary conditions of wind and tide at the present date; and also, in my opinion, the railroad company should be prepared to supplement this opening at an early date with two additional trestle work openings, cut down to low tide level, and of at least 100 feet length each, one near each shore. In my opinion, any increase of opening at the railroad bridge alone will tend to restore the former better conditions of the river navigation, even should nothing be done at the State bridge; and, therefore, the railroad company should in justice be required to commence the work immediately on the 100-feet-width draw opening of its own bridge, whether or not any work be ever done at the State bridge.

As regards the difficulties of construction of such a draw of 100 feet clear width and 25 feet depth at low tide, I can see no excessive trouble for first class railroad engineers of the present day. The existing foundations of the original (and present) causeway should by this time be so compacted and solidified as to make an excellent foundation for the new piers and abutments. The 800 feet width of navigable channel at this part of the river will allow of the construction of a new draw in comparatively shoal water and without disturbing the old draw, and it would in my opinion be quite possible to build the new piers and abutments without for more than a few days interfering with the regular traffic of the railroad.

As to the time needed for the construction of a new draw, the original notice allowed about 15 months from the time of the hearing; and the railroad company had no objection to offer to this at that time. In order that they should have an approximately equal period of working time from the present date (allowing for a possible stoppage of work by the severe winters of this locality) I think they should be given until the 1st of July, 1894; this allowance of time being also, in my opinion, a reasonable one for the construction of the work to be required.

ARGUMENTS IN FAVOR OF LARGER DRAWS.

With only two exceptions (that of the Business Men's Association of Newport, R. I., and the Old Colony railroad) all persons concerned, on both sides of the question, are unanimous in asking for the widening of the draw opening of this bridge.

Petitions.

The following is the list of the principal petitioners:

March, 1888.—D. T. Church and about 90 others of Tiverton and Providence (see A, 3, herewith), (Tiverton being one of the four towns responsible for the repair of the bridge).

24 March, 1888.—John W. Davis (then governor of Rhode Island) and about 100 others, of Providence and other places (including many members of the Rhode Island legislature), (see A, 3, herewith).

April, 1888.—Town council and about 170 others of Little Compton, R. I. (see A, 3, herewith). (Little Compton being one of the four towns responsible for the repair of the bridge.)

The above (about 360 in number) unite in asking for two draw openings, each 100 feet wide and 25 feet deep.

23 July, 1890.—D. T. Church and about 70 other citizens of Tiverton and Portsmouth. About 190 masters, pilots, and crew of boats using Seaconnet river. The commodore and about 50 members of Fall River Yacht Club. The commodore and about 60 members of Rhode Island Yacht Club (see 7825, Engr. Dept. 1890; 1398, B, 2, War Dept. 1891).

The above (about 370 in number) united in saying that steamers, sloops and schooners have been seriously damaged, and men drowned, on account of this bridge draw; and that it takes from five to six hours to get through one bridge, and from ten to twelve hours to get through both bridges, and that this bridge is an obstruction to navigation and danger to life.

14 March, 1891.—Julius A. Petty, captain of steamer "Queen City," formerly schooner captain, states his personal knowledge of loss of life, damage to boats, and loss of time caused by this bridge. (See 1679, 4, Engr. Dept. 1891; 1398, 5, War Dept. 1891.)

March, April and May, 1891.—Sixty-two captains, masters, pilots, of steamers and schooners by circular letter, claim that on account of the obstructions of these bridges they are forced to go around another way, thereby losing up to 14.5 miles in distance whenever sailing from Narragansett bay to the east, or returning. (See 1679, 8 to 61, Engr. Dept. 1891, and 1614, 1 to 12, Engr. Dept. 1892; 1398, B, 1 to 11, War Dept. 1891; 1398, 6 to 48, War Dept. 1891; and 1640, 1 to 8, War Dept. 1892.)

24 February and 11 April, 1891.—Committee of complainants; ask for two draw openings, each 100 feet wide by 25 feet draft. (See 1679, 63-64, Engr. Dept. 1891; 1398, B, 13-14, War Dept. 1891.)

23 March, 1891.—William Reed, Jr., and about 100 others, claiming to represent $1,000,000 of capital invested in shipping and real estate affected by the bridge, ask for greater depth, and 100 feet width of draws. (See 1679, 73, Engr. Dept. 1891; 1398, B, 23, War Dept. 1891.)

STATEMENTS AT HEARINGS AND SINCE.

Extent of River Travel.

Present Travel.—Of course the present travel is not as great as it would be if there were no obstructions. One regular steamer and occasional excursion steamers run during the summer from Providence and other parts of Narragansett bay through the bridge to the mouth of the Seaconnet river, and this travel is stated at over 17,000 passengers in a single season. (See D, herewith.)

Schooners and sail boats use this route a little, but as little as possible at present, on account of its difficulties, delays and danger.

The combined travel is still enough to be very evident; and enough so that one insurance company alone (see A, herewith) claims to carry $200,000 insurance on vessels and cargoes passing through the bridges.

Probable Future Travel.—As stated under the heading of "History of Bridge," the Seaconnet river was and is naturally one of the outlets of Narragansett bay, and is naturally by far the easiest and shortest route for vessels going from the Taunton river and upper Narragansett bay to Nantucket sound and the east. The saving in distance (measured on Coast Survey charts) is at least 3 miles in case of vessels coming from or going to Providence, 4 miles in case of Warren, 6 miles in case of Bristol, 12 miles in case of Coles river, Fall River, Somerset, Dighton and Taunton, and 14 miles in case of Tiverton; all of these places being important shipping points. The Taunton river alone has a commerce of at least 400,000 tons or $6,000,000 per annum (see p. 616, Annual Report, Chief of Engineers, for 1892). Fall River also has a very large commerce by schooners as well as by steamer. At Tiverton is the very large fishing station of the Church Brothers, so large as to use elevators capable of loading 1,000 barrels of fish per hour (see p. 35, herewith), that use 8 fishing steamers of 60 to 160 feet length, from 8 to 15 feet draft, and from 16 to 45 feet width over all (see p. 5 D, herewith), and a large part of whose work is done eastward of the Seaconnet river. The possible loss per season to them alone is shown by the computation that 50 round trips for each of 8 steamers at 14 miles extra route each way, making nearly 12,000 extra miles, costing from, say $2,000 to $12,000, according to circumstances. They claim for themselves during 1888, 1889 and 1890, an extra distance thus traveled by their 8 steamers of 20,000 miles, and their total loss by extra travel and by time taken from actual work on the fishing ground, as $30,000 annually (see A, 4, herewith).

Over 60 boat captains and pilots nave already made individual statements (see references under head of "Petitions") that they are forced about 14 miles out of their route every trip to this vicinity.

The Fall River Yacht Club (through Mr. Burdick) and the Rhode Island Yacht Club (through Mr. Janes), representing 125 yachts, and some of from 9 to 12 feet draft, claim that the present bridges obstruct their use of the river, and oblige them to go around instead of through this river; that a yacht's loss of time often carries with it a financial loss; that such loss has already been recognized legally; and that, therefore, the yacht clubs, as a sort of secondary commerce, are entitled to some considerations in matters of river travel (see D, herewith, and specially 1679, 69, Engr. Dept. 1891; 1398, B, 19, War Dept. 1891).

It is not merely the extra distance in miles of travel that causes the protest of boat captains against being obliged to go around Newport island instead of through the Seaconnet river; but it is more especially the fact that the shorter route often avoids head winds, cross tides, the dangerous Brenton reefs (at S. W. of island), and exposure to the worst seas of this part of the coast. On this account the short cut, via Seaconnet river, would save not merely 14 miles of travel, but often a whole day's delay of waiting for favorable winds and tides, or of fighting against adverse ones. This may readily be seen by an inspection of the Coast Survey charts. Certainly, the Seaconnet river route would be considerably used by schooners and small boats, both of commerce and pleasure, if there were an easy passage for them through the bridges.

Damage already Caused.—Accidents and delays to boats have been referred to at all hearings and denied by no one. Amongst these so reported the following are prominent:—

The steamer "Queen City" has, on occasion, had to make five consecutive attempts at running through the draw before succeeding, and only then after twice being flung in upon the piers or abutments by the swift currents and eddies. (See D, herewith). Mr. Angell (see A, herewith) reports having his schooner stove in; Capt. Pettey, his schooner sunk in the draw (see A, herewith; also 1679, 4, Engr. Dept. 1891; 1398, 5, War dept. 1891); and Capt. Macomber, once his schooner having its stem knocked off, and at another time having her planking stove in and timbers broken (see 1679, 6, Engr. Dept. 1891; 1398, 4, War Dept. 1891). And at least one man has been drowned in the draw through the capsizing of his boat by the swift current (see 1679, 4, Engr. Dept. 1891; 1398, 5, War Dept. 1891.)

The adjacent town of Tiverton, by special letter from its town council (see E, 6, herewith), asks for a wider and deeper draw; and the city of Newport, through its mayor at the hearings (see p. 45 of F, herewith) states that property and life are imperilled by the bridge.

The State of Rhode Island, through a representative of its Bridge Commission, states that commerce and life are endangered (see p. 3 of C, herewith); and later the Bridge Commissioners as a body, in their special report to the General Assembly of Rhode Island (see p. 5 and 7 of G, 1, herewith; also 1679, 67, Engr. Dept. 1891; 1398, B, 17, War Dept. 1891), and in speaking of their own bridge, state further that "It is a notorious fact that this bridge is a serious * * * * obstruction to * * * * navigation * * * * and an injury to the commercial and maritime interests of the people * * * * and is a source of danger to life and property * * * * and practically closes the Seaconnet river to navigation," adding that "The Old Colony railroad bridge * * * * is a still worse obstruction," and adding also that "The Old Colony railroad bridge is mentioned * * * * because at the hearings the officials and representatives of the Old Colony Railroad Company attempted to justify the leaving of their bridge in its present condition, under cover of the Stone (State) bridge being left as it is by the State * * * * (see pps. 7-8 of G, 1, herewith).

Admissions by the Bridge Owners.

At none of the hearings has any one attempted to deny or disprove any of the statements of the complainants as to the actual damages or delays caused to steamers and schooners by this bridge.

Arguments Against any Changes.

The main protests against the proposed changes are naturally those of the railroad company, and these are naturally mainly based upon the cost of such change. The claims of the railroad company are shown in detail in the minutes of the various hearings, and also in special written statements (see 1679, 66, Engr. Dept. 1891; 1398, B, 16, War Dept. 1891; also pps. 1 to 4 of B; E, 4; and pps. 10 to 43 of F; all herewith). They may be briefly summarized as follows:

1. That the River and Harbor Act of 1890, so far as it delegates to the Secretary of War certain powers over commerce and bridge obstruction is unconstitutional (see page 3 of E, 4, herewith).

2. That this bridge is a structure legalized by the State of Rhode Island and within its own territory, and cannot be removed except by process of law and with compensation for damages caused by its removal (see p. 3 of E, 4; pps. 12 and 33-4 of F; and also F, 9 and F, 10; all herewith).

3. That the proceedings thus far on the part of the United States are legally invalid, because the hearings are not those contemplated in the River and Harbor Act of 19 September, 1890, not having been held before the Secretary of War in person; and also because the testimony has not been sworn to (see pps. 10 to 14, 41 to 43, and 96 of F; and p. 1 of E, 4, herewith).

4. That the required draw is wholly out of proportion to the needs of present or any probable future commerce of the Seaconnet river (see p. 2 of E, 4, herewith).

5. That so large a draw would be impracticable and dangerous (see p. 2 of E, 4, herewith).

6. That its cost would be very great, not less than $400,000 (see p. 2 of E, 4; also pps. 35-36 of F, herewith).

7. That the suspension of all railroad traffic during the draw construction would be very long (at least one year), and very inconvenient to the adjoining cities (see p. 3 of E, 4, herewith).

8. That any change of the railroad bridge would be useless until after a corresponding change were made in the State bridge (see p. 1 of B; p. 12-13 of F; herewith).

In only one of these points, the 7th, did the railroad receive any support from any one else. In this case, the Business Men's Association of Newport, R. I. submitted resolutions (see p. 88 of F, herewith; also 1679, 83, Engr. Dept. 1891; 1398, B, 31, War Dept. 1891) protesting against any change, on account of the inconvenience to the city; but the value of this protest is much diminished from the fact that this association is merely a social club (not a Board of Trade), is not the only club of business men in the city, and has no data on which to base any definite statistics of commerce (see F, 7, herewith), that its resolutions were passed by a vote of only 16 to 10 (2 being guests and 1 other being an official of the Old Colony railroad) at a meeting where about 100 were said to be present from an association numbering over 160 members (see pps. 86, 87, 95, 56 and 57 of F, herewith), and that even this action was based mainly upon the just published statement of the Old Colony railroad (see p. 3 of E, 4 and p. 56 of F) that the bridge would cost $400,000, and would involve the suspension of all direct railroad connection with Newport for an entire year.

The points of these arguments will be taken up by me in succession, for discussion in detail.

As to the first point, that concerning the right of delegation of authority by Congress to the Secretary of War; this right appears by the phraseology of the River and Harbor Acts of several years past to be one claimed by Congress, and therefore to be enforced until pronounced unconstitutional by the Supreme Court.

As to the second point, that of shelter behind State laws; a glance at the Coast Survey charts will show that the Seaconnet river is one of the navigable waters of the United States (in contradistinction to that of the State of Rhode Island) according to the long established definition of the Supreme Court (Treasury Decisions 1613 in 1873, 4376 in 1880, Navigation Laws of the United States, 1886, page 150), being one that "Forms in its ordinary condition, by itself or by uniting with other waters, a continued highway over which commerce is or may be carried on with other States and foreign countries in the customary modes in which such commerce is conducted by water;" so that the rights of the State are therefore those of mere temporary occupancy of the channel bottom, allowable only so long as it does not interfere with the rights of navigation. The inter-State (and therefore the United States) character of this particular water way is specially testified to by the Rhode Island State Commissioners in their special report on the adjacent State bridge, made to the Rhode Island State Assembly in January, 1892 (see last three lines page 8 of G, 1, herewith).

As to the third point, the validity of the hearings; these hearings have been conducted in strict compliance with the instructions of 16 September, 1891, from the office of the Secretary of War, and of General Order No. 6, of 19 September, 1891, from the office of the chief of engineers. As regards the question of a hearing before the Secretary of War in person; it was the opinion of the Judge Advocate General's Office, under date of 3 September, 1891 (see p. 4 of 1679, 78, Engr. Dept. 1891; 1398, B, 27, War Dept. 1891), that such personal hearing in the first instance was "impracticable," and that mainly for such reason "All the information furnished and views advanced by the parties should be in writing," in order that it should be in shape to later receive the individual or personal consideration of the Secretary of War. As regards the question of "sworn" testimony; there might in the case of some bridges be some doubt as to the accuracy of statements; but in this case, as far as concerns statements as to the unreasonableness of the bridge obstruction, the records of the various hearings show that "The serious and permanent obstruction to navigation," and "The danger to life and property" offered by this bridge, is a "notorious fact," and "uncontroverted at the hearings," so much so, in fact, that the Rhode Island State Commission do not hesitate to use these very words in their own official report to the State Assembly (see p. 5 and 7 of G, 1, herewith; and as far as concerns other statements, such statements are usually either of such nature that their mere statement makes them self-evident (see points under the heading of Hydraulic and Engineering Considerations), or they are of the nature of opinions which must, even if sworn to, be weighed and qualified by the Secretary of War in passing judgment upon the main question at issue.

As to the fourth point, the question of relative value and needs of the two varieties of travel, that over the bridge and that through the draw; the question is naturally one of technical opinion. The amount of present and future travel and damage to past navigation has been elaborated already by me, under the head of "Arguments in Favor of larger Draws," and so need not be repeated here.

As to the amount and value of the railroad traffic; the president himself of the road states that "Its business is small," that this is the case of an unimportant railroad, and alludes to its "light traffic" (see 1679, 66, Engr. Dept. 1891; 1398, B, 16, War Dept. 1891). The manager of the road states that their normal travel is 12 trains per day (see page 1 of B, herewith). Their time tables show at present an average of 6 passenger trains each way daily on week days, and 1 train each way on Sundays. Though specially asked to submit statements of the amount of their business over the road, they have not as yet done so. Upon the railroad's own statements, their traffic and travel is hardly large enough to justify such continued injustice to navigation as is vouched for by the State Commissioners.

As to the size of the draw, 100 feet width; the president of the railroad claims (p. 2 of E, 4) that 100 feet width is nearly three times the width of the draw openings of other existing New England bridges where the navigation is at least 100 times as great; and the railroad manager (p. 1 of E) localizes this statement by saying that the Boston (Mass.) bridge draws are only about 36 feet wide. These statements are undoubtedly true; but the Boston, and other bridges referred to, are generally across comparatively narrow inland rivers or channels, and between high banks or buildings, where tides, winds and waves are of small account. Moreover, the Joint Board of Railroad and Harbor Commissioners of Massachusetts (Sen. Doc. No. 179) in April, 1871, found these Boston draws so unreasonably unjust to navigation that they recommended that the bridges should be reduced in number and replaced by constructions on isolated piers, with 100 feet width of permanent span, and with two openings of 60 feet width each at the draw spans (see p. 3476, Annual Report Chief of Engineers, for 1890). At the Seaconnet river the 30-feet-depth channel has nearly 800 feet width, winds, waves and tides are at times strong, and the railroad bridge is at present a solid causeway save at its single small draw-span opening. Further reasons for a least width of 100 feet at this place have already been elaborated by me under the head of "Hydraulic and Engineering Features," and others, or the same in different form, are given by the complainants in the attached papers (see p. 1 of F, 4; p. 54 of F; and 1679, 65, Engr. Dept. 1891; 1398, B, 15, War Dept. 1891). On the other hand, the road bed, with its rights of way and terminal facilities, is of evidently great value to the Old Colony railroad. The cost merely of so much of the land, as was purchased and presented to the railroad by the city of Newport alone in 1860, is roughly stated by the mayor (see p. 46 of F, herewith) at $98,000 at that early date, and, judging from the well known abnormally rapid and great increase in value of all property in this neighborhood in late years, the gain in value of their road bed alone must be enough to pay for the construction of several draws like that at present required. Moreover, the railroad facilities at Newport are almost a necessity to the Old Colony combined railroad and steamboat line, as a reserve terminal during the ice bound months of winter.

As to the fifth point, the impracticability and danger of so large a draw; the question is also one of technical opinion. I see no reason for any fear in this direction. The adjacent stone highway bridge, referred to by the Old Colony railroad president (E, 4, herewith), as partly washed away two or three times, is at the head of an arm of the ocean, and exposed to waves coming over a long reach and deep water; while the railroad bridge, protected from ocean exposure by the State bridge, is itself only exposed to the waves from an inland bay of much quieter and shallower water (see Coast Survey maps). Moreover, from the method of construction of the railroad causeway, as described by its president (p. 2, of 1679, 66, Engr. Dept. 1891; 1398, B, 16, War Dept. 1891), the new draw will have an excellent and solid foundation to rest upon at 30 feet depth (see p. 1 of E, 7; also p. 1 of 1679, 69, Engr. Dept. 1891; 1398, B, 19, War Dept. 1891), and from the increased width of opening the new piers and abutments will be much relieved from the present severe tidal scour (see p. 2 of F, 4; p. 54 of F; all herewith).

As to the sixth point, the great cost of the required change; here again the question is one of technical opinion. The chief engineer of the Old Colony railroad estimates the cost at about $450,000 (see p. 35-36 of F, herewith); while the complainants estimate the cost at not over $100,000 (see F, 5; also pps. 60 to 73 of F; all herewith). The estimate of the Old Colony railroad is undoubtedly an outside one, their counsel himself stating (p. 37 of F) that this was a case of the "Best most expensive." The Old Colony estimate (p. 35 of F) provides for 19,000 cubic yards of excavation (equal to a volume 45 feet depth by 45 feet width by 250 feet length), and for 9,000 yards of masonry (equal to a volume 6 feet width by 45 feet depth by 900 feet length), and for 44,000 yards of rock filling (equal to a volume of 45 feet depth by 45 feet width by 570 feet length), which is a very liberal estimate for two openings of 100 feet each (only one being specified by the Secretary of War), with the best of guard piers on both sides of both abutments and of the center pier, and the whole on the supposition of the new draw being located in the deepest part of the river [which is neither necessary, nor specially desirable by navigation, nor required by the Secretary of War. (See p. 55 of F; also p. 4 of F, 4; and E, 2; all herewith.)]. Still further, the prices quoted for rock filling are very high, considering that large hills of rock are adjacent to the bridge and to the Old Colony railroad track. In my opinion the amount of work specified in the notice of the Secretary of War (E, 2, herewith) may easily be done within the estimates of $100,000 submitted by Mr. Janes, C. E., on the part of the complainants. Any cost in excess of the latter will in my opinion be due to work done by the railroad in their own interests to save themselves future trouble and expense, and not because it is really required at present by the Secretary of War.

As to the seventh point, the suspension of railroad traffic during the construction of the new draw; here, again, the question is one of technical opinion. The president of the railroad in a letter prepared by him for publication in the newspapers, just before the last hearing, claims (see p. 3 of E, 4) that all traffic over the bridge would have to be stopped for a whole year. The complainants (see p. 3 of F, 4; p. 56 and 84 of F) claim that such stoppage is not at all necessary, giving their reasons. My own views to the same effect are already given above, under heading of "Hydraulic and Engineering Features." There are several methods by which any stoppage of travel might easily be avoided, such as:—the use of a temporary track on one side of the causeway while the work was being done on the other side; or the use of temporary overhead trusses, underneath which the new piers and abutments may each be excavated; &c. Other railroads have overcome far greater obstacles in such work; and the Old Colony railroad may safely be relied upon to find some such practicable method to avoid losing their valuable connections with Newport, as a summer resort, and as a winter wharf terminal. Moreover, the question of suspension of travel is that of inconvenience to the railroad travel for only a short time, against that to the river travel for all future years.

As to the eighth point, the uselessness of any change in the railroad bridge draw before a similar change is made in the State bridge draw; this, also, is a question of technical opinion. The president of the railroad (see p. 2 of 1679, 66, Engr. Dept. 1891; 1398, B, 16, War Dept. 1891) and the manager (p. 1 of B, herewith) and the railroad counsel (p. 12–13 of F, herewith) claim that it would be useless to make any changes in the railroad bridge alone. On the other hand, the complainants (p. 2 of 1679, 66, Engr. Dept 1891; 1398, B, 19, War Dept. 1891; and p. 82 of F) claim that the building of this bridge has increased "tenfold" the difficulties of the river navigation, and that the proposed change at this bridge alone would be of very much benefit. My own opinion, very decidedly to the same effect, is elaborated above under the heading of "Hydraulic and Engineering Considerations."

Remedies Suggested.

If a wider draw is to be required, it is by no means necessary that this should be secured by the widening of the present one where the water is naturally about 50 feet deep. The 30-feet-depth extending over about 800 feet width of channel, it is fully as advantageous to navigation to have the new draw opening near one shore where the water is only about 30 feet deep, as to have it in the middle of the causeway where the depth is about 50 feet. Such construction will probably be also a far more economical arrangement for the railroad; and it seems to me that they should be given the option of adopting it rather than be forced to widen the present draw. The phraseology of the late notice served upon them for the last hearing (see E, 2. herewith) would, moreover, allow of this; although the railroad in its estimates of cost of the new draw did not seem to have taken any advantage of this privilege.

Conclusions and Recommendations.

After a study of all the past correspondence and records of hearings upon this bridge question, and after a personal inspection of the locality at several different times, I am of the opinion that the present and probable future boat travel through this bridge is of a good deal of importance in comparison with the railroad travel over the bridge, and enough to require immediate modification to the bridge; that the present bridge is an unreasonable obstruction to navigation on account of its insufficient width of span and depth of water, and that it ought to be provided with at least one draw span of at least 100 feet clear width and 25 feet depth at low water.

Under all the circumstances of locality both of bridge and waterway, it seems to me that the bridge and waterway have each so much of an inter-State character that it would be perfectly just and proper that at least the deepening of the draw opening should be left to future appropriations by the United States under the provisions of the River and Harbor Appropriation Act, and that the railroad company should not be required to do more than provide for the increased width of waterway. Moreover, the notice served upon the railroad company at the last hearing (see E, 2) did not specify any particular depth in the draw opening.

Further, it seems to me that the railroad company should be allowed until the first of July, 1894, in which to construct the new draw and draw-opening; this allowance of time being in my opinion a reasonable one for such work.

I have, therefore, in the case of the Old Colony Railroad Bridge over the Seaconnet River, near Tiverton, R. I., to recommend that the Secretary of War, in accordance with the provisions of Section 4 of the River and Harbor Act of September 19, 1890, give notice to the Old Colony Railroad Company that they shall provide their bridge before the first day of July, 1894, with a draw having an opening of one hundred (100) feet in width in the clear; and to recommend further that he, at the same time, caution the road that the needs of navigation will probably soon require this opening to be deepened to twenty-five (25) feet depth at low water, and that the piers and abutments of the draw span ought to be constructed accordingly.

Respectfully submitted,

W. H. BIXBY,

Captain, Corps of Engineers, U. S. Army.

Encl. G, 4, to 7th indt. of Feb. 8, 1893, upon 1679, 77, Engr. Dept. 1891.
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